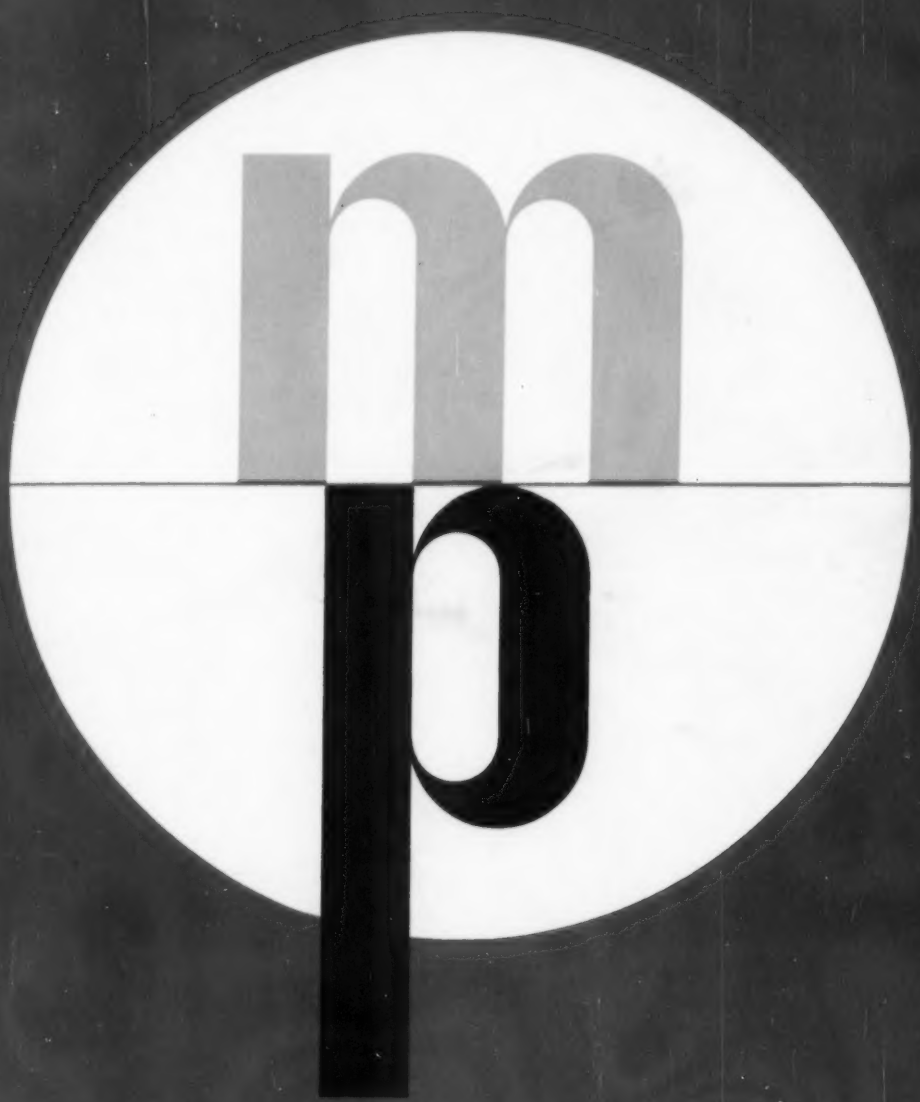
MODERN PLASTICS

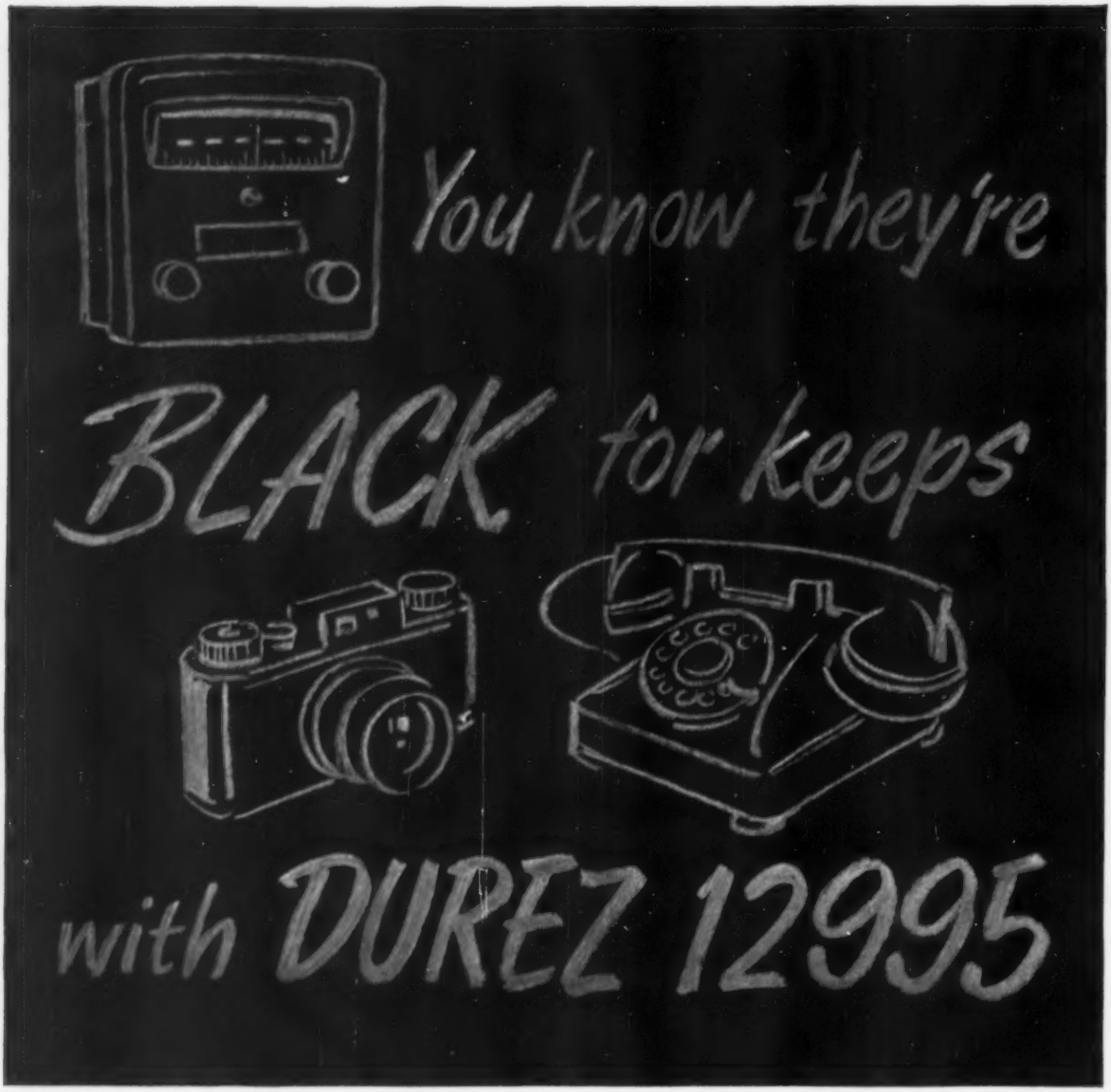


May 1956

page 33 **The Plastiscope, Section 1 . . .**

fast reading news of the industry

page 89 **Beginning: A world survey of plastics**



When plans call for a black surface with a rich, velvety luster that years of rugged service will not dim, Durez 12995 is your number.

The long-lasting beauty of this phenolic material makes it unequalled for camera cases, telephone hand sets, instrument housings and the like. It resists dulling and pimpling caused by moisture and body acids, and retains its fresh-from-the-mold appearance through long periods of rough handling. If machining and sanding are necessary, molded parts regain their original luster when buffed.

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Packaging Containers featured are molded by Plastic Jewel Co., Inc., 1112 Brook Ave., Bronx 56, N. Y.

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MODERN PLASTICS*

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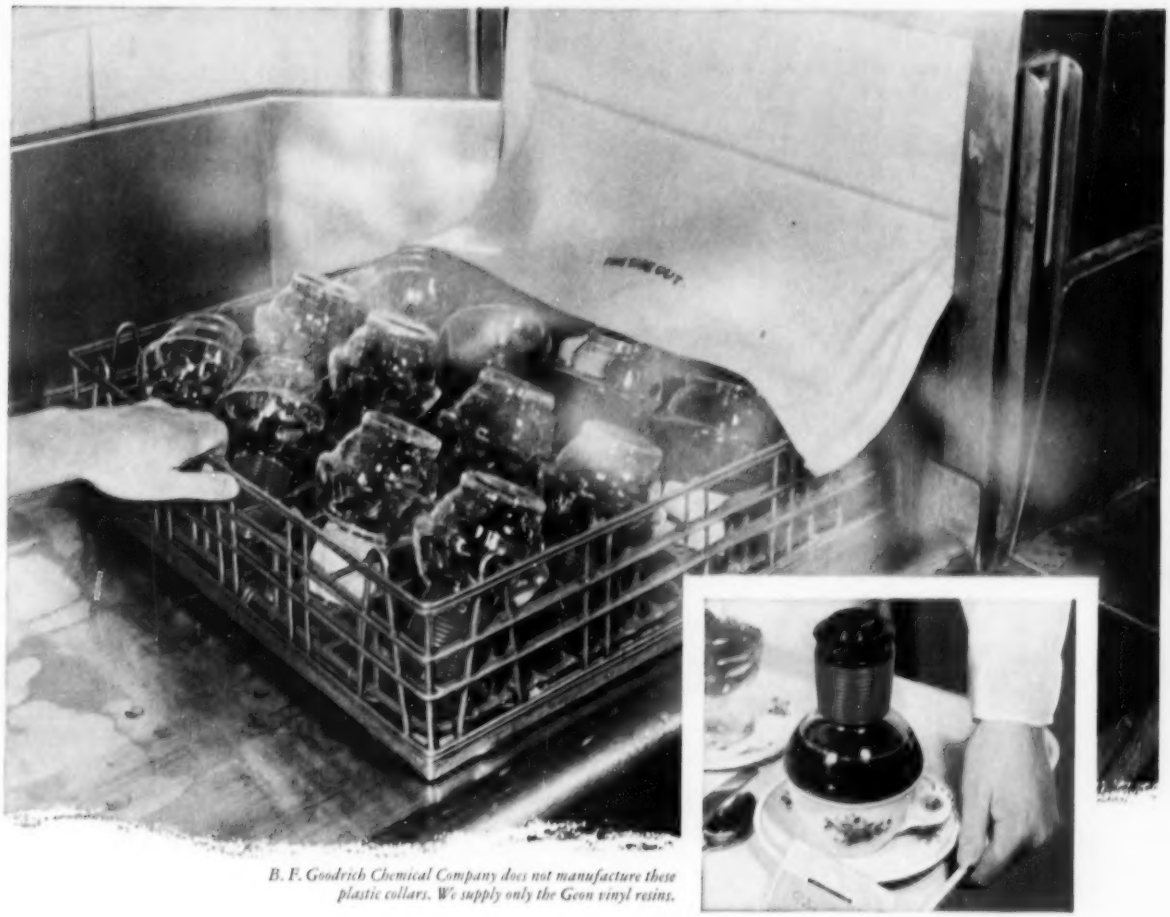

B. F. Goodrich Chemical Company does not manufacture these plastic collars. We supply only the Geon vinyl resins.

Geon plastic collar wins battle with live steam

HERE'S a dramatic example of the versatile qualities of Geon polyvinyl materials — a plastic collar for coffee Hottles® that comes through sterilization in autoclaves or dish washers without damage.

Other types of collars unwind, chip or peel under live steam or boiling water so necessary for hospital, hotel and restaurant sterilization. Because this new collar is made from Geon it resists grease, detergents, acids and abrasion. Besides providing heat insulation, the collar is decorative — comes in a choice of six colors.

The collar is injection molded from Geon, dilated and shrunk onto the neck permanently. This application from Geon suggests similar uses as protective sleeving for the electrical and chemical industries.

The remarkable properties of Geon have made it the starting point for many sales successes. You will find this versatile vinyl in colorful and wear resistant upholstery, in high dielectric insulation, in rigid pipe and in protective coatings. For information on Geon please write Dept. DS5. B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

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This wall plaque is made from a single piece of woodgrain-finish CAMPCO sheet illustrating the variety of effects obtainable by applying both transparent and opaque colors. Plaque was formed by Kirby-Cogeshall-Steinau Co.

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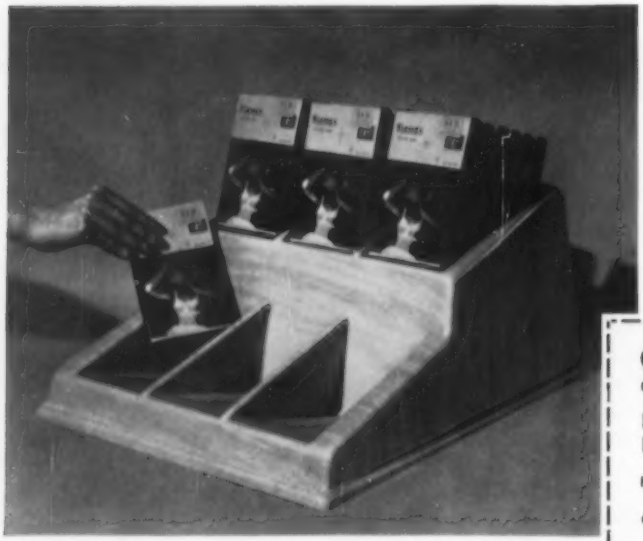
Be sure to see CAMPCO at the National Plastics Exposition — New York, June 11-15, booths 526 and 528.



Warner Brothers "A'lure" bra display, made from woodgrain-finish CAMPCO sheet by Newhart Products.

CAMPCO Division of
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Editorial

Know-how: two-way street

Plastics industry leaders from all parts of the world will come to the National Plastics Exposition in New York next month. The importance of this show to these men may be measured in terms of their time and their expense. They seek to see what's new in materials, processing methods, machinery, and applications in the United States, to discuss that most important intangible, American "know-how," and to take home ideas whereon they may build a bigger business.

Every foreigner visiting the show will have something to offer to every American he meets. Problems and opportunities inherent in materials source situations, in standards of living, and in the availability of technical talent have caused these peoples to direct plastics development along lines which are well worth careful study in this country. Their "know-how" may be just as valuable to us as ours to them.

In Delft, Holland, the Plastics Research Institute, T.N.O., is conducting research on new polymers and copolymers which promise to shatter precedent as violently as did the catalytic method of polymerizing ethylene.

In Israel the Weizmann Institute, challenged by the Dead Sea as a perpetual source of bromine, is coming up with bromine resins and with copolymers made from bromine-containing monomers.

In Pakistan there are huge supplies of jute; accelerated development work is being done on its use as reinforcement for plastics, especially for applications in construction.

In France a complete plastics home has been built, a full year in advance of a similar project in the United States. It is now being tested from the standpoints of livability, efficiency, and economy.

In Italy the swing to petrochemicals as plastics sources is due to produce new and valuable materials. Italian extrusion techniques have already beneficially affected the American industry.

Beyond the major developments in each country are the minor bits of "know-how," involving product design, tool design, specialized application of plastics.

The foreign plastics men who will be visiting the show are leaders in the industry in their own countries. To meet them will be a privilege and an opportunity, because "know-how" is a two-way street.

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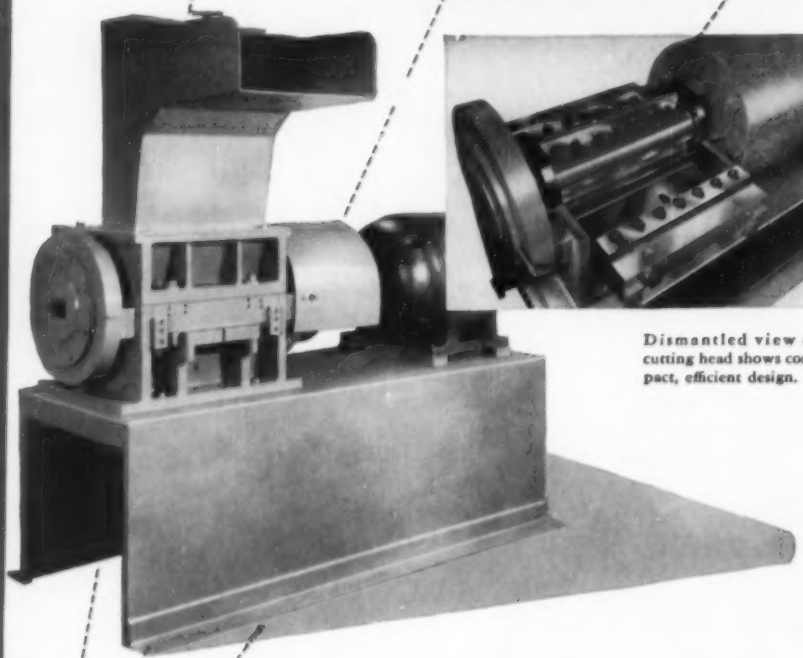

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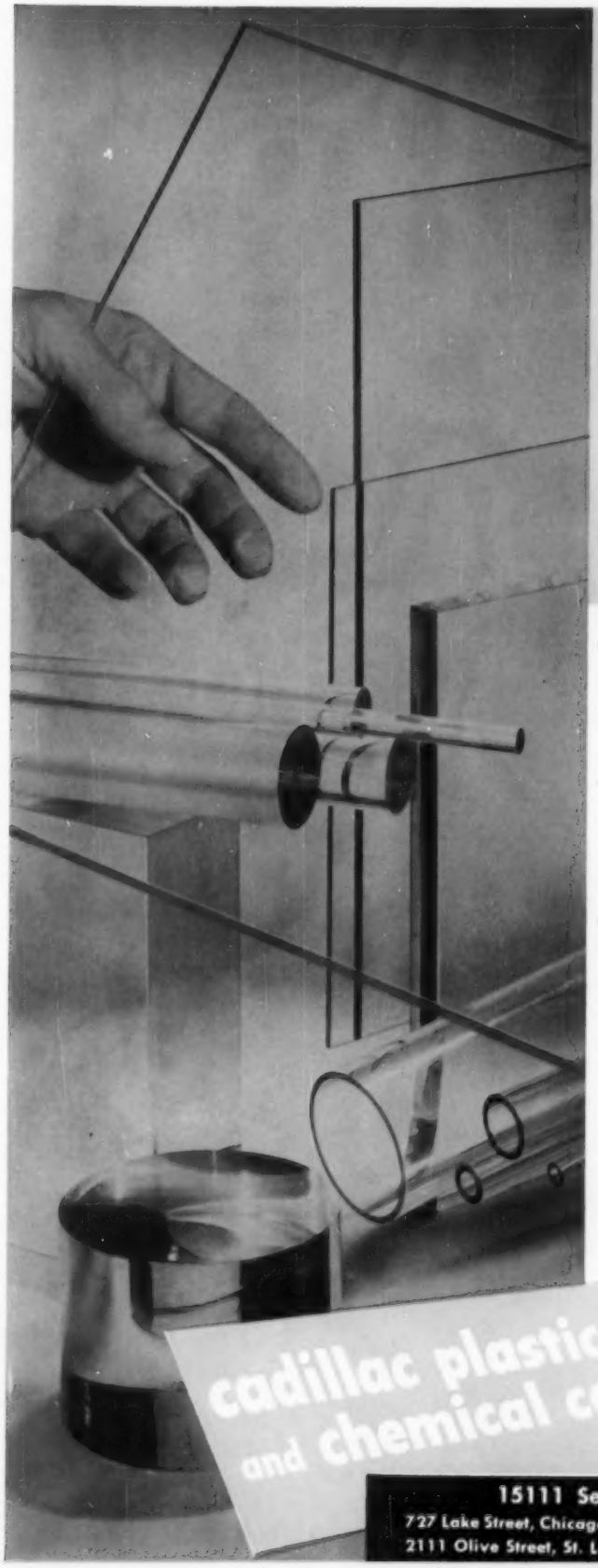

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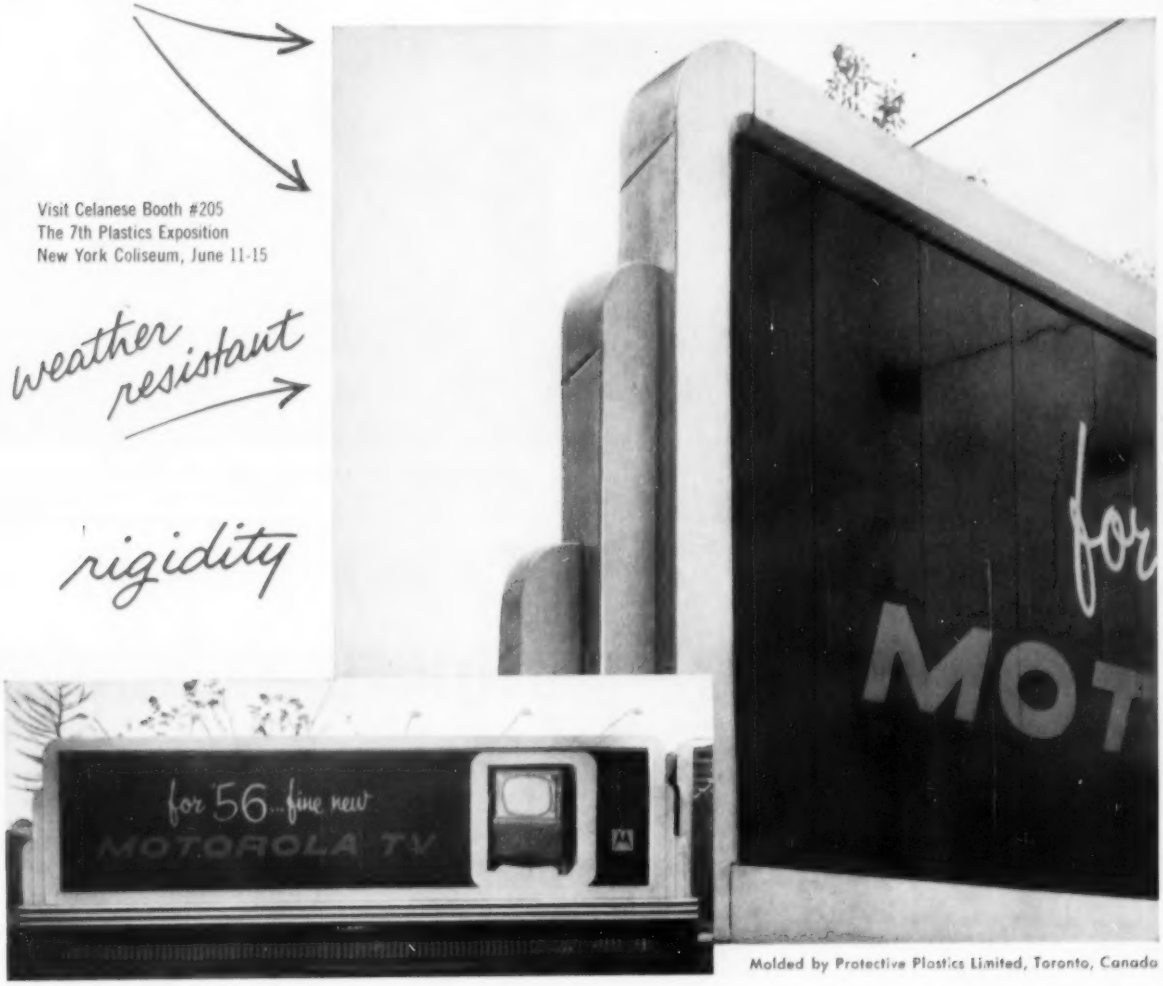


Molded by Protective Plastics Limited, Toronto, Canada

Celanese* Marco Resins make the big jobs easy

This new billboard frame is strong and rigid—yet light enough for two men to assemble in a short time. It stays new-looking in all kinds of weather and needs no periodic spruce-up job. It gets away from conventional frame design yet is easy to construct. It's another example of the freedom of design and construction simplicity possible with reinforced plastic fabrication.

Today a growing list of outsized products can be made more economically—and better with reinforced plastics—using simple, inexpensive dies and low-pressure speed-molding. Molded or fabricated of Marco Resins, these products can be given steel-like strength without excess weight. They are especially resistant to atmospheric heat, cold, vibration, impact and stress. Linings, inserts, ports can be incorporated. Color can be molded in. Truck-bodies, airplane parts, structural panels, boats—if you're designing or building on a small or grand scale, it will pay to study the latest information on reinforced plastic construction.

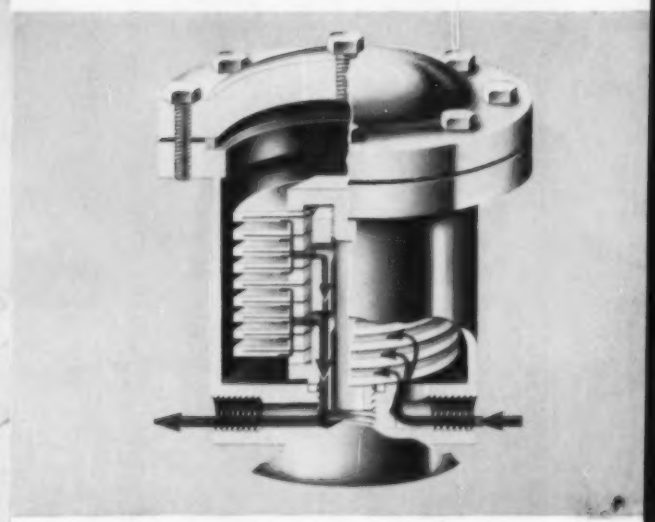
Write to Celanese Corporation of America, Plastics Division, Dept. 101-E, 290 Ferry Street, Newark 5, N. J. Canadian affiliate, Canadian Chemical Company, Ltd., Montreal, Toronto and Vancouver.

Celanese*

*Reg. U. S. Pat. Off.

plastics and resins

ALATHON® is lightweight and shatterproof . . . water- and chemical-resistant, and tough and flexible over a wide range of temperatures . . . an ideal material for housewares applications.



TEFLON® is chemically inert. Used in molded form as a lightweight, compact filter, it is well suited for use with strong acids, alkalies, oxidants and organic solvents.

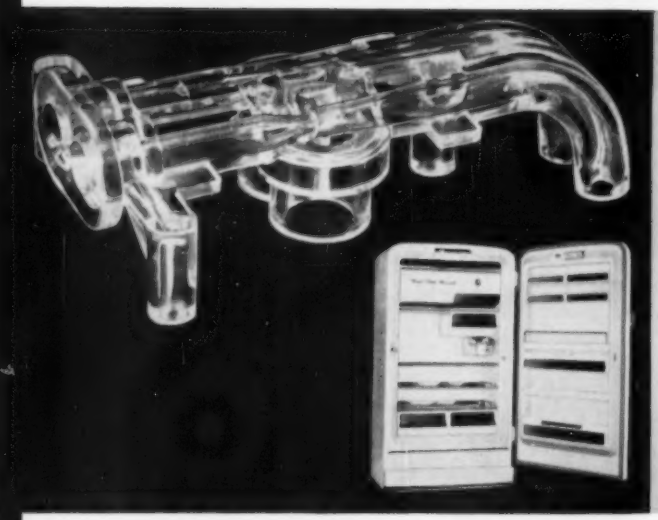
more examples

The examples shown here are typical of the improvements that have been made by an imaginative use of Du Pont engineering materials. Perhaps you can utilize these versatile materials in your operation. You will find their unique properties offer you opportunities for simplifying designs, increasing product efficiency and, oftentimes, cutting costs.

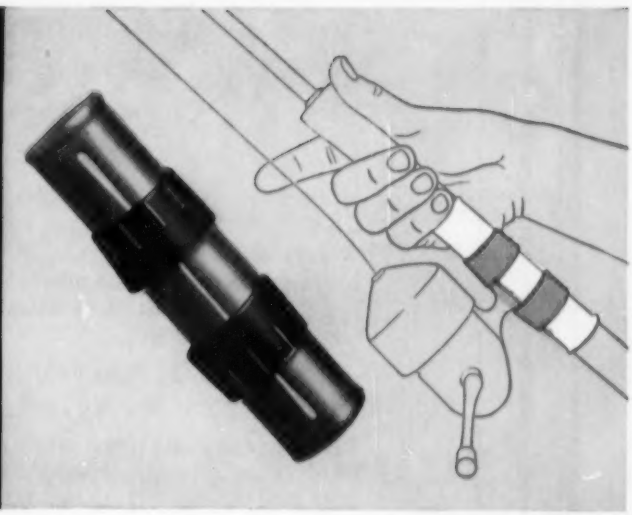
ALATHON® polyethylene resin is especially suited for the manufacture of housewares. It is lightweight, tough and flexible over a wide range of temperatures, has excellent chemical and water resistance, and is free from taste, odor and toxicity. Colorful housewares of Du Pont "Alathon" will not crack, chip or peel and they are shatterproof.

Other uses for "Alathon" include electrical insulating applications for high-frequency wires and equipment; insulation and jacketing for wire and cable; packaging in the form of film, bottles and other containers; pipe and fittings for water and chemicals and a wide variety of toys, plant maintenance items and safety equipment.

TEFLON® tetrafluoroethylene resin is inert to virtually every commercially employed chemical or solvent and has a useful temperature range of −450°F. to 500°F. Its extreme chemical inertness, resiliency and toughness recommend "Teflon" for use in gaskets, packings and component parts of pumps, agitators and mixers. "Teflon," in porous form, offers a filter medium unmatched by any other material. It is able to handle such severe corrosives as fuming nitric acid,



LUCITE® is readily molded into complex shapes. Its sparkling clarity makes this juice-mixing valve easy to inspect for cleanliness.



ZYTEL® is used for this durable, molded fishing-reel seat. Fitting tightly over the rod handle when the reel is mounted, it will not twist or wobble and cannot rust or rot.

# of advanced product engineering

hydrofluoric acid, hydrogen peroxides and concentrated caustics. (Filter manufactured by Porous Plastic Filter Co., Inc., A Pall Filtration Co., Glen Cove, New York.)

LUCITE® acrylic resin is easily molded into intricate patterns and has a relatively high impact strength even at low temperatures. It is transparent, light in weight and chemically resistant. The venturi valve for the "Automatic Twin Juicer," used in Westinghouse refrigerators, is molded of Du Pont "Lucite." It is easily inspected for cleanliness and resists the chemical action of juices and other food substances. (Valve manufactured by the Dole Valve Co., Chicago, Illinois. "Lucite" molded by Chicago Molded Products Corp.)

ZYTEL® nylon resin features toughness, abrasion resistance, form stability, strength even in thin sections and chemical resistance. It maintains high impact strength even at below-freezing temperatures. "Zytel" is used to make the Fast-Lock fishing-reel seat illustrated. It assures a viselike grip without damage to the cork handle, is comfortable to hold, and will not rust or rot. (Reel seat of "Zytel" molded for the South Bend Tackle Co., Inc., South Bend, Indiana, by Engineered Nylon Products, Inc.)

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The Greeks had a word for it-

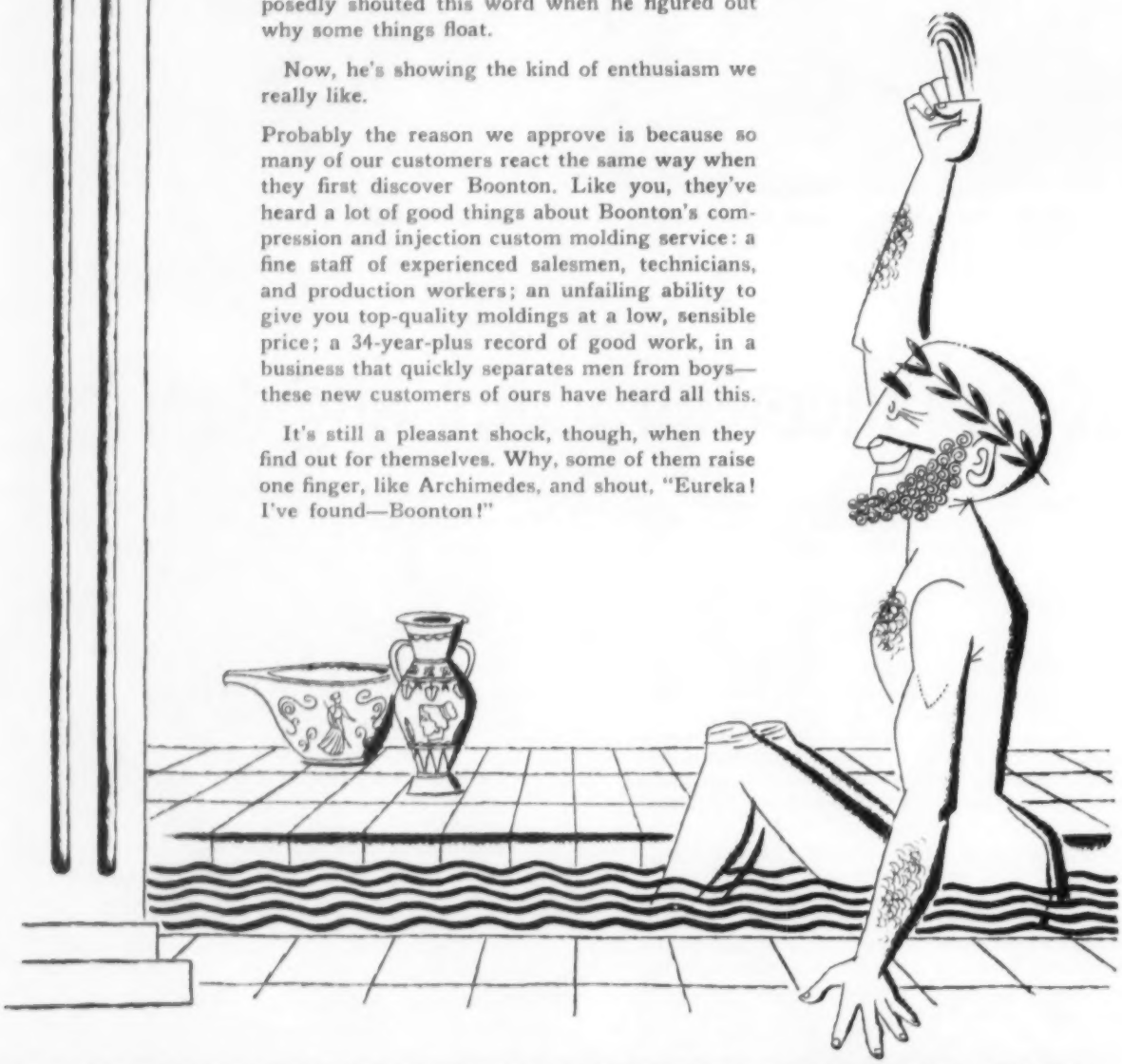
Eupnka!

—which, in English, is spelled Eureka. It means, "I have found it!," and the distinguished Greek bouncing excitedly in his tub—Archimedes—supposedly shouted this word when he figured out why some things float.

Now, he's showing the kind of enthusiasm we really like.

Probably the reason we approve is because so many of our customers react the same way when they first discover Boonton. Like you, they've heard a lot of good things about Boonton's compression and injection custom molding service: a fine staff of experienced salesmen, technicians, and production workers; an unfailing ability to give you top-quality moldings at a low, sensible price; a 34-year-plus record of good work, in a business that quickly separates men from boys—these new customers of ours have heard all this.

It's still a pleasant shock, though, when they find out for themselves. Why, some of them raise one finger, like Archimedes, and shout, "Eureka! I've found—Boonton!"



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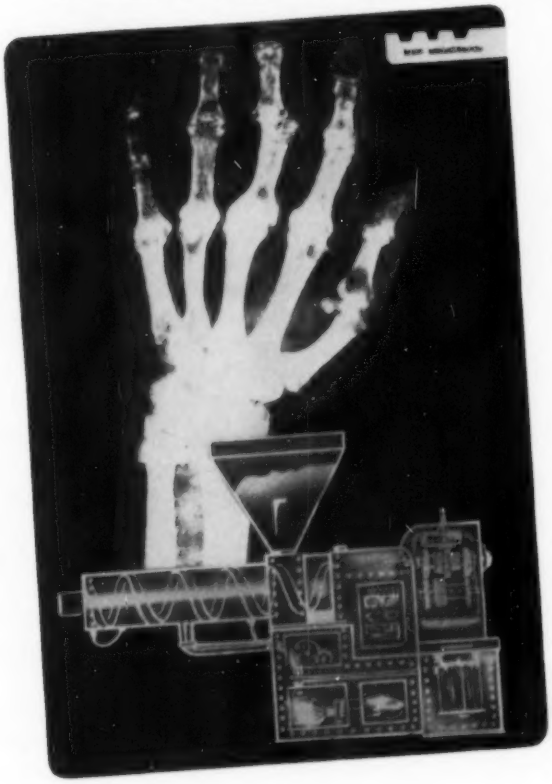

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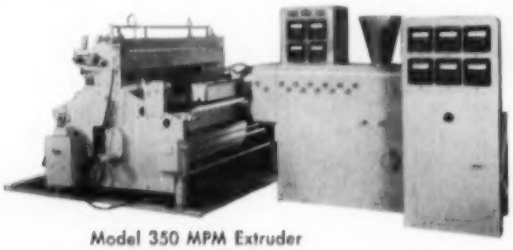
- ★ Simplicity of operation.
- ★ Electronic heat control.

We Welcome Inquiries and are prepared to demonstrate and instruct you in the operation of the completed installation before shipment. Such cooperation explains why many manufacturers, even in foreign countries, operate MPM Units profitably from the start.



Model 350 MPM Extruder
with C-74 Sheet Takeup

modern plastic machinery corp.

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THE MOST ADVANCED PLASTIC PROCESSING EQUIPMENT

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Answer to an absorbing

In manufacturing dry blending vinyl resins, the primary problem is to produce a resin which will accept plasticizer at a rapid, yet uniform rate. The resin also must give a sandy or free-flowing mix, must process easily on any type of forming equipment and must do so at no sacrifice of physical properties.

In developing a resin to meet these requirements, Goodyear vinyl specialists first made a microscopic examination of resin particles at various stages of dry blending. From this they found that the plasticizer first is quickly adsorbed as a thin layer on the surface of the particle. Then as heat is transferred to the particle, this layer moves inside or is absorbed.

This study also revealed the importance of particle size, shape and structure to proper plasticization and indicated the nature of the particle needed. With this background, the researchers set out to tailor-make a series of dry blending resins.

Pictured at right is one result of their efforts – particles of a typical PLIOVIC DB (dry blending) resin under magnification. Note how well these particles of PLIOVIC answer the requirements for porosity and uniformity. Note also how thoroughly they are plasticized as indicated by their high degree of translucency.

In addition to their excellent plasticizing properties, the PLIOVIC DB resins are readily calendered, extruded or molded, exhibit maximum physical properties, permit you to take safe advantage of the speed and low cost of dry blending. Write for details, samples and the latest *Tech Book Bulletin* to:

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Chemigum, Plioflex, Pliolite, Plio-Tuf, Pliovic—T. M.'s The Goodyear Tire & Rubber Company, Akron, Ohio

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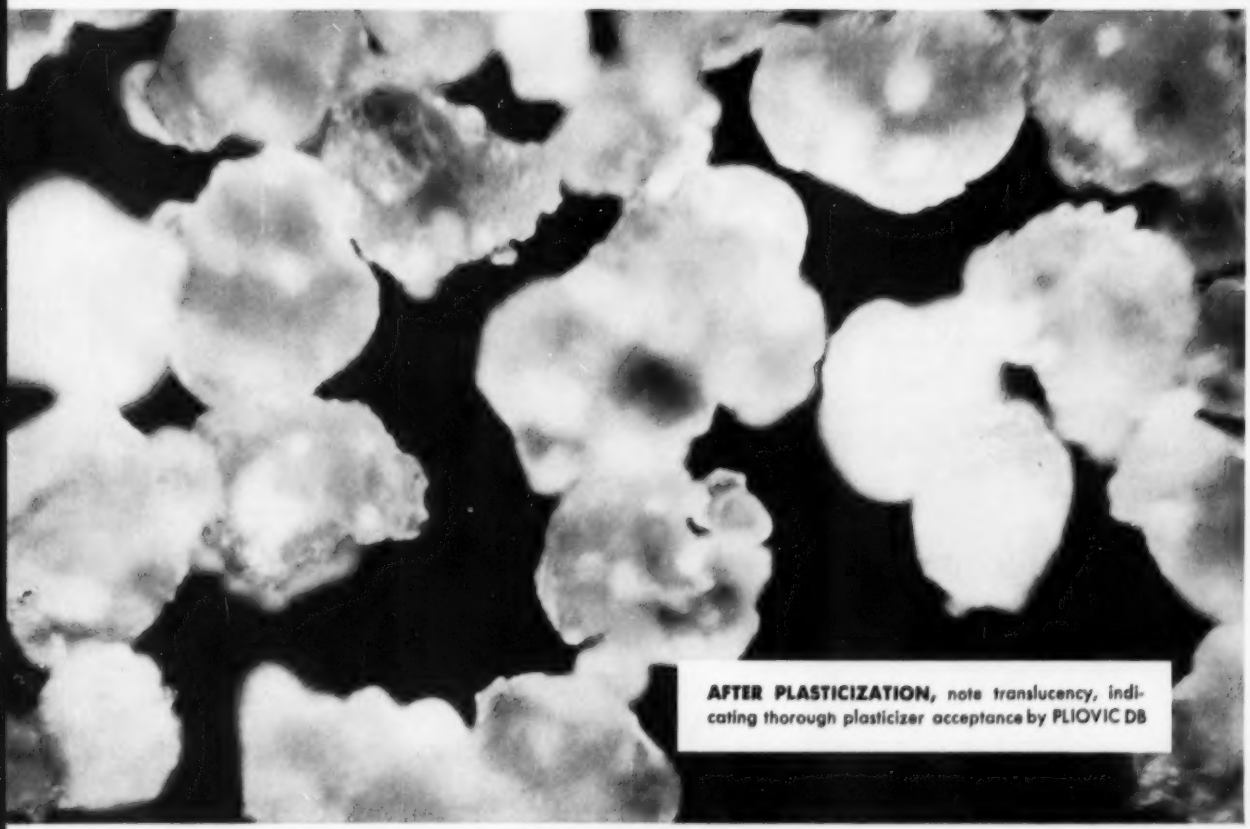
High Polymer Resins, Rubbers, Latices and Related Chemicals for the Process Industries

BEFORE PLASTICIZATION, note uniformity and porosity of particles of PLIOVIC DB resin

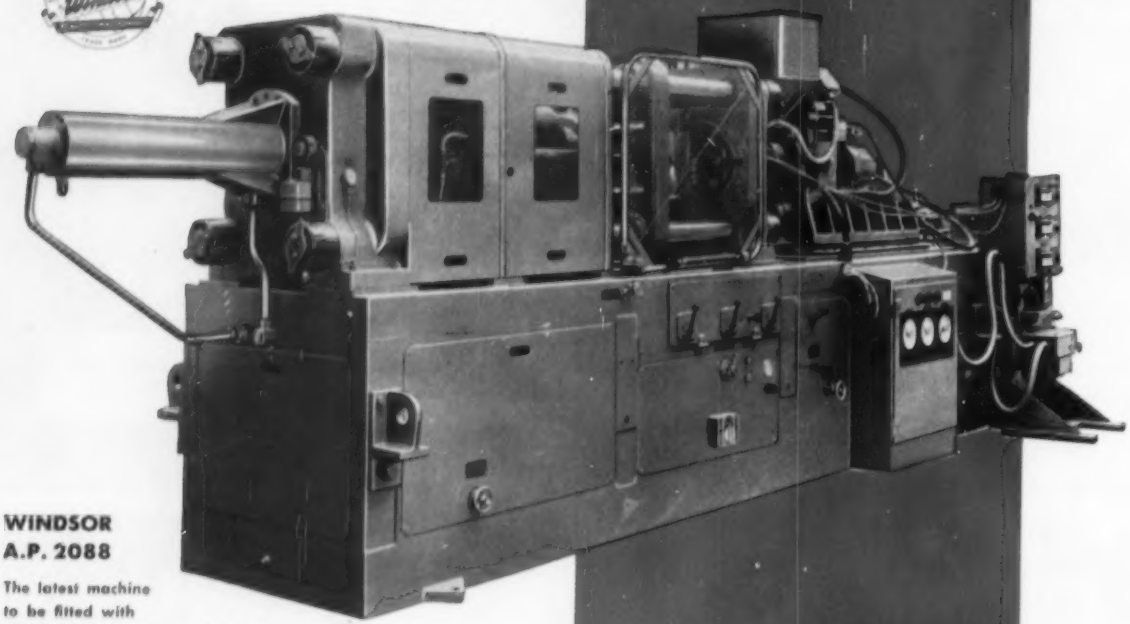


AFTER PLASTICIZATION, note translucency, indicating thorough plasticizer acceptance by PLIOVIC DB

"AUTOPLAS"

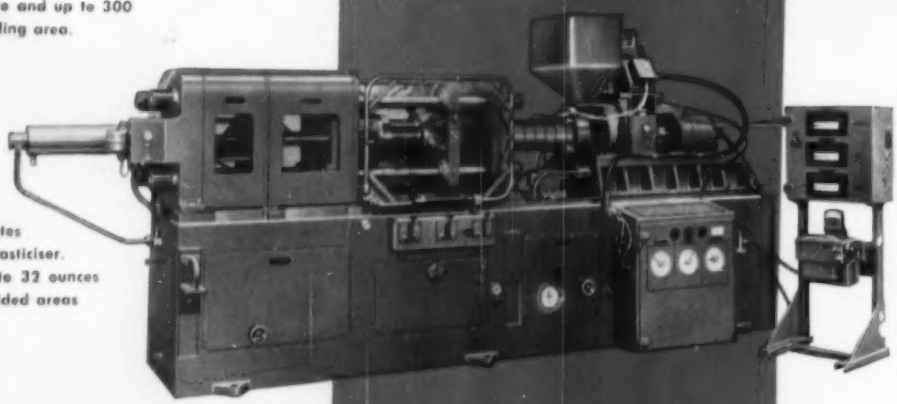
Single Stage Multi-screw

PRE-PLASTICISERS



WINDSOR
A.P. 2088

The latest machine
to be fitted with
the twin-screw type pre-plasticiser.
Produces stress-free mouldings up to
64 ounces in Cellulose Acetate and up to 300
square inches projected moulding area.



WINDSOR A.P. 1044

This unique machine incorporates
the famous twin screw pre-plasticiser.
Produces large mouldings up to 32 ounces
of Cellulose Acetate and moulded areas
up to 160 square inches.

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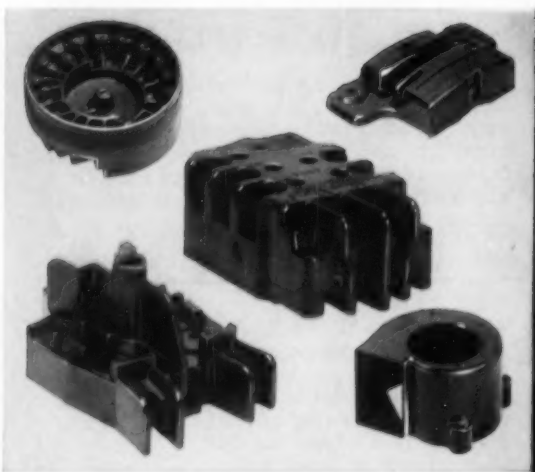

in plastics too ... *our fame is your fortune.* The success of Kurz-Kasch is more than just luck. Here, you'll find men who know and understand your problems. Men who can advise you by *reading the convolutions of your plastic parts and not the bumps on your head.*

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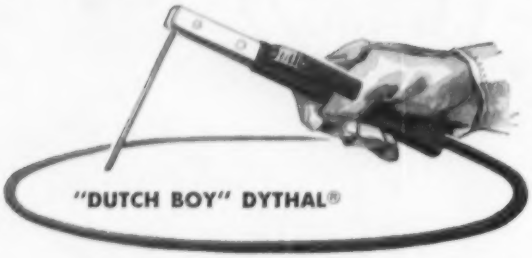
in vinyl-insulation stabilizing

...the "*Dutch Boy*"...

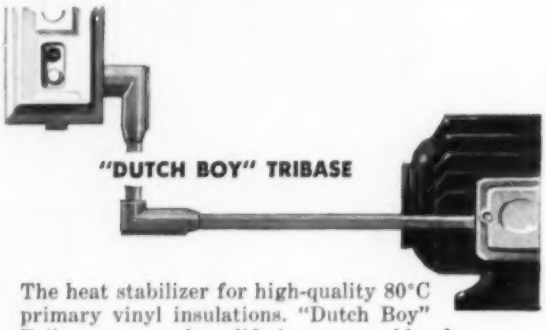
with *five* versatile stabilizers

one for every wire and market



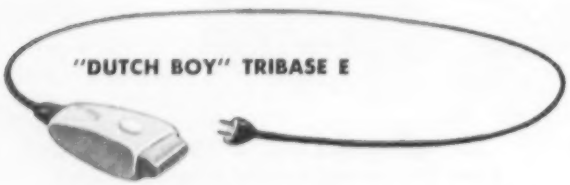
"DUTCH BOY" DYTHAL®

The standard of the industry for stabilizing primary vinyl insulations of the 90°, 105°C class . . . arc-welder cables, TV internals, pyrometer leads, for example. "Dutch Boy" Dythal is compatible with polyesters, disperses easily. It shows excellent tubing characteristics and withstands high extrusion temperatures.



"DUTCH BOY" TRIBASE

The heat stabilizer for high-quality 80°C primary vinyl insulations. "Dutch Boy" Tribase assures long life in power cables for machine tools, soldering irons, appliances, and similar devices. It eliminates gassing, color instability, moisture pick-up. Dispersion and tubing characteristics are both excellent.



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Widely used for flexible SPT-type vinyl cords. Leads for lamps, light-duty tools, Christmas tree lights and other portable appliances are often stabilized with Tribase E. It is one of the best low-volume-cost stabilizers, with excellent general properties.

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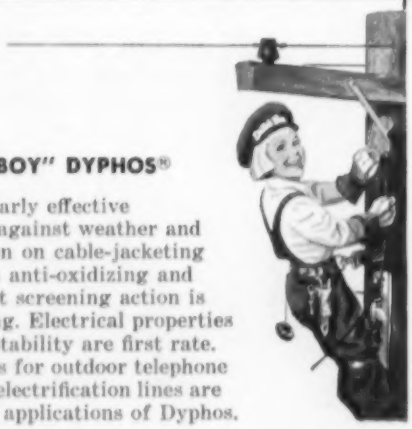
Newest of the "Dutch Boy" "electrical" stabilizers, Lectro "60", is outstanding for economy (specific gravity only 4.0) and volume resistivity *plus* excellent water resistivity. It is unique in ease of dispersion and is recommended for sensitive plasticizers. An excellent stabilizer for T and TW wires.



"DUTCH BOY" DYPHOS®

A particularly effective stabilizer against weather and light action on cable-jacketing stocks. Its anti-oxidizing and ultra-violet screening action is outstanding. Electrical properties and heat stability are first rate. Insulations for outdoor telephone and rural electrification lines are important applications of Dyphos.

Maybe the five "Dutch Boy" Stabilizers above can help you improve quality and control cost in making vinyl insulations. Or perhaps you would like information on what other "Dutch Boy" Stabilizers can do for you. Just write National Lead's technical staff.

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prehardened MOLD STEEL

preferred again!

by the mold maker

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because...

1. Easier to machine
2. Polishes to a higher lustre
3. Uniform in hardness
4. Heat treat problems eliminated

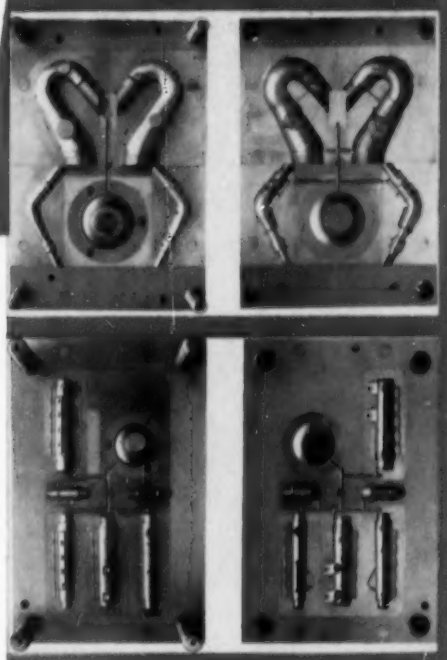
by the molder...

PROLL TOYS, INC.

Newark, N. J.

because...

1. Excellent production performance.
2. Superior finish on molded parts because of high finish on Cascade mold.



Cascade molds for injection molding polystyrene toy saxaphones and clarinets.

These are typical reasons why Cascade plastic mold steel is preferred by leading mold-makers and molders.

For your next quality mold specify a quality mold steel—*Latrobe's Cascade!* Call your nearest Latrobe representative . . . a wide range of stock sizes are available from conveniently located warehouses.

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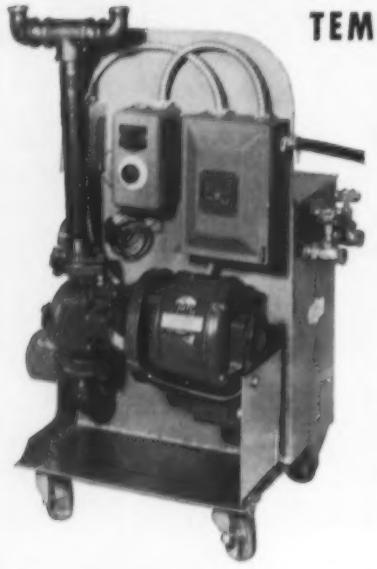
MAIN OFFICE and PLANT: LATROBE, PA.

BRANCH OFFICES AND WAREHOUSES LOCATED IN PRINCIPAL CITIES

INJECTION MOLDERS!
BOOST PRODUCTION!

FOR CONSTANT MOLD TEMPERATURES



The IMS Economy Circulator. Priced at only $369.50 complete (oil model for heats to 450° at $462.50). Duplicates performance of mold heaters costing up to 6 times as much. Developed by a molder for molders. Compact — only 15" x 22½" floor space.

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The IMS M-3 6½" x 7" throat sprue grinder—rugged—simple in design. Easiest to clean. Built-in throat clearance bar. Casters. Catch Pan.

PRICE Complete with 1 HP Motor and Starter.....$548.50

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Automatically Keeps Hoppers Full

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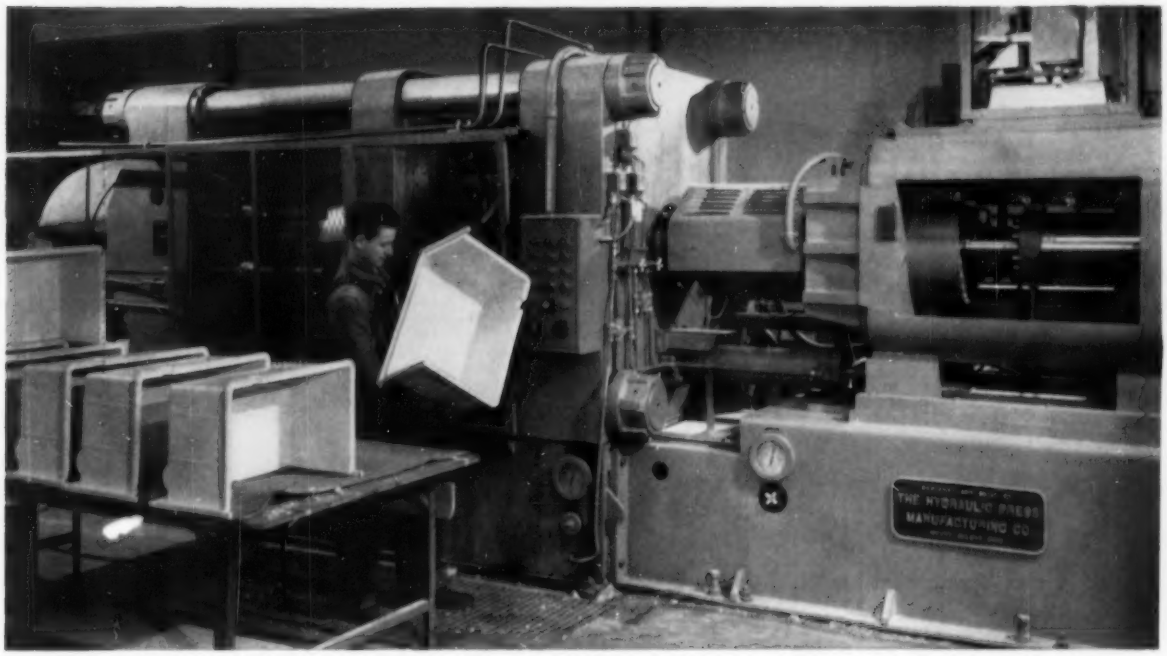
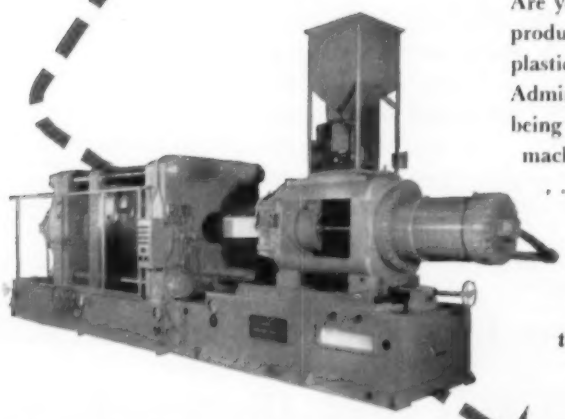
ready for "BIG" Business?



H-P-M 80 oz. *the answer to Big Part Production . . .*



Freezer chest parts are molded on H-P-M 80 oz. injection machine at Molded Products Division, Admiral Corporation, West Chicago, Illinois.

Are you ready for the new, big markets for Plastic parts and products? Forecasts emphasize the growing trend toward plastic parts in every industry. This large freezer chest for Admiral Refrigerators is a typical example of large area parts being molded on the H-P-M 80 oz. injection machine. This machine has everything a molder could ask for . . . speed . . . plenty of stroke . . . extra plasticizing capacity . . . large mold area . . . large injection plunger diameter for full capacity "shots." Get ready for new business now. Modernize your production with H-P-Ms which are available in sizes from 6 to 400 ozs. Write today for the facts . . . ask for Bulletin 5601.

HPM

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THE HYDRAULIC PRESS MFG. CO.
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NOW . . . FASTER DELIVERIES !
ON D-M-E STANDARD MOLD BASES!

EXPANDED FACILITIES SAVE YOU TIME . . !

Now . . . you can get FASTER DELIVERIES on the highest quality Standard Mold Bases even though the demand has reached an all time high!

This availability has been made possible by the recent expansion in D-M-E's manufacturing facilities. With D-M-E's Hillside, New Jersey plant doubled and additions at the Detroit, Michigan plant completed, production of Standard Mold Bases is now geared to meet the ever-increasing demands of the Industry.

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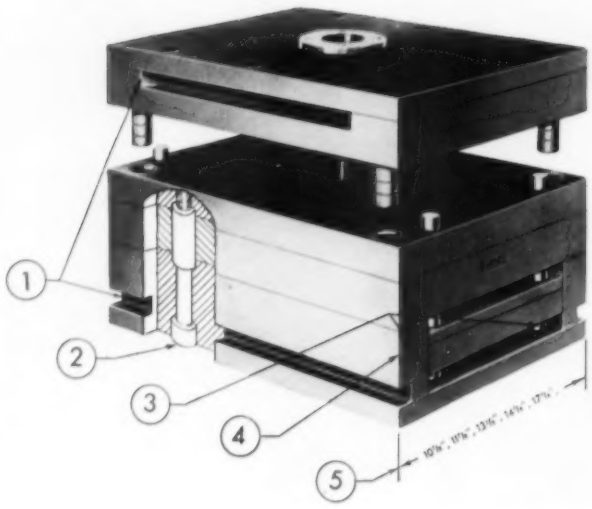

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   Eliminates space-wasting "clamping ledges"
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quality controlled **Plenco** Phenolic Molding Compounds

For serving food or music, Plenco phenolics take honors for practicality, versatility and production savings. This has been the experience of not only the manufacturers and molders of gleaming modern kitchenware and instruments of musical reproduction . . . makers of countless other types of products, have benefited as well, with Plenco.

The *casserole* shown above has attractively molded handles that resist heat. The *turntable* resists warp and wear. That is why Plenco 349 is suggested for both applications.

First, Plenco 349 offers significant property improvements compared to prior materials designed for high heat resistant applications. Parts molded of Plenco 349 withstand oven temperatures over extended periods of 480° F., many moldings in excess of 500° F.

Second, Plenco 349 also has properties of low shrinkage, excellent dimensional stability of molded parts, low water absorption and excellent solvent resistance.

Plenco 349 compound has a low specific gravity (1.55-1.56), compared to conventional heat resisting compounds, permitting more parts per pound. Its exceptionally smooth surface, clean jet black luster and easy mold release are pleasing to end user and molder alike. We suggest you consider Plenco 349 on your next application requiring high heat resistance or dimensional stability. We believe it can do an excellent job for you.

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FOR BETTER PLASTIC PRODUCTS

PLASTICS ENGINEERING COMPANY
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. . . Time to wake up and let PEERLESS show you what's new in Plastics Marking.

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PEERLESS Roll Leaf Company has marked practically every type of plastic . . . has made equipment for marking most every size and shape of plastic product . . . and continues to be first in their field with new advancements in plastics marking, and the manufacture of plastics marking machinery.

Come on now, sleeping is all right at home, but not during a working day . . . wake up . . . call or write PEERLESS . . . let us tell you "what's new".

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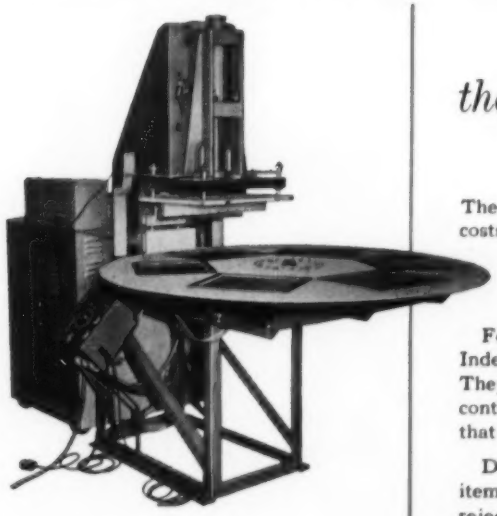
AUTOMATION by Thermatron

HIGH FREQUENCY SEALING AND HEATING EQUIPMENT



the fast, more profitable way to weld vinyl plastics!

The watchword today is *automation* to increase production, lower costs and improve quality . . . And for fabricators of vinyl plastics, Thermatron offers the best in fully automatic electronic welding equipment for large and small consumer novelty and industrial products.

For example, the illustration shows a Thermatron Automatic Indexer used with a Thermatron Generator and large P-36 Press. They feed, index, weld and rewind complete rolls of vinyl in one continuous operation. You just flip the starting switch. From that point the machine takes over on its own!

Discover for yourself how Thermatron can weld your plastic items at high speed with constant quality and practically no rejects. Write today for full details including our trade-in offer on your old equipment . . . And ask for a copy of bulletin 104.

Thermatron Division

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In Radio and Electronics Since 1922

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OTHER RADIO RECEPTOR PRODUCTS: Radar, Navigation and Communications Equipment; Selenium Rectifiers; Germanium and Silicon Diodes

Another Opportunity Chemical from General Mills

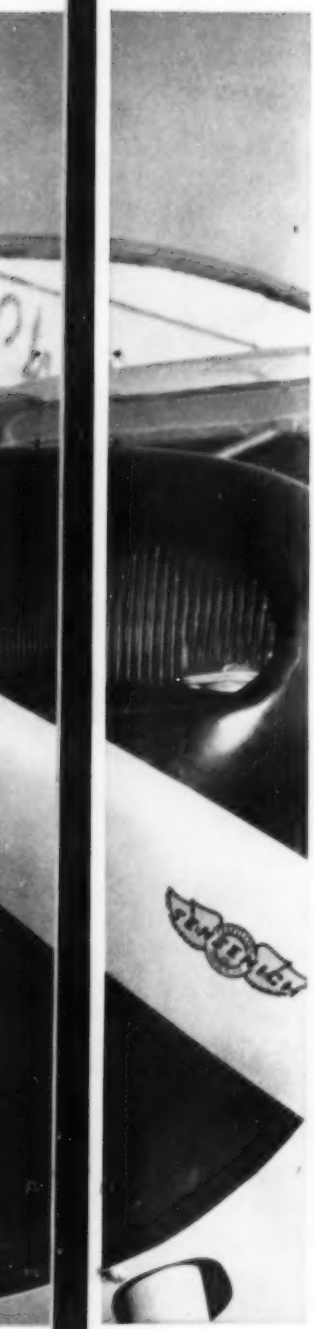
Tough, low-cost plastic easy to make with

Plastic lathe fixture, left, is used to make propeller spinners at Champion Aircraft Corp.

*Investigate Versamids the versatile polyamide resins made only by...

CHEMICAL DIVISION

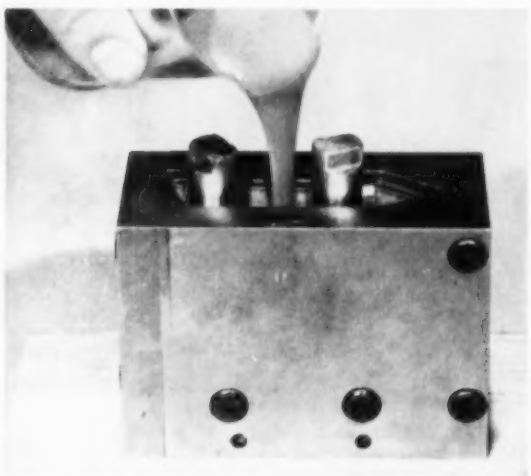
tools and dies are Versamid*-epoxy alloys!



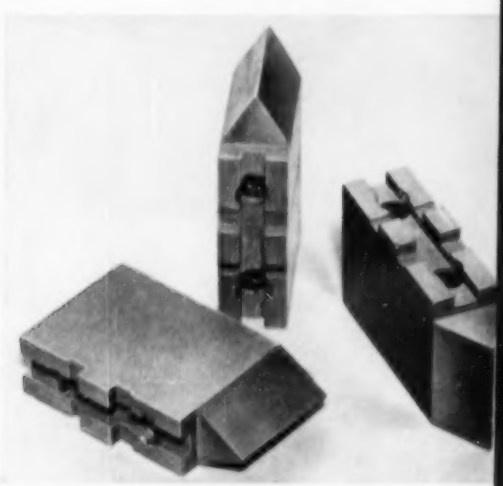
Strong, lightweight plastic tools have passed rigid, practical tests and are in daily use in aircraft, automotive and other industries. Champion Aircraft Company of Osceola, Wis. is one of many manufacturers who have found Versamid-epoxy alloy tooling economical, efficient, and a valuable aid to their business. Thermosetting alloys of Versamid-epoxy resins are being used to produce aluminum and even heavy gauge steel stampings. These alloys show high impact strength, are extremely easy to work with, and can be formulated to yield almost any set of properties desired.

It's easy to make durable Versamid-epoxy tools, as shown below.

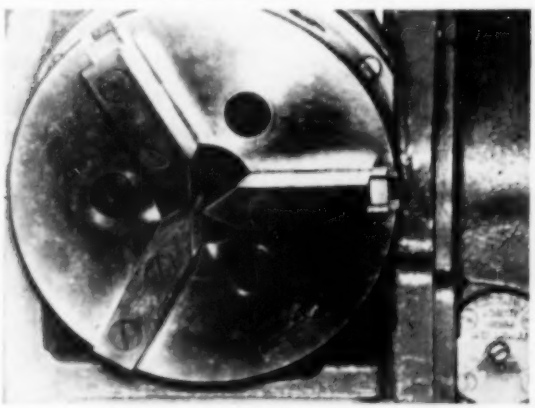
Maybe tools and dies aren't your problem, but chances are you can use Versamid polyamide resins to save time and money in other applications. Tough industrial finishes, plastic body solder, structural adhesives, rugged plastic laminates . . . these are but a few of the known and tested uses for versatile Versamids. Only Versamid polyamide resins do so many jobs so well, and only General Mills makes Versamids.



1. Here an alloy of Versamid 125, epoxy resin, and aluminum powder is poured into a brass mold.



2. These soft jaws, or chucks, are molded from Versamid-epoxy alloy at extremely low cost.



3. Finished three-jaw chuck is in regular use on a lathe at General Mills Mechanical Division.

For more detailed information, write for the Spring issue of *Progress Thru Research.* It carries a fact-filled article on plastic tooling. If possible, name your needs for specific advice on the application you're considering. Please note that General Mills does not market plastic tool and die alloys . . . only the Versamid polyamide resins used in such alloys.

OF General Mills KANKAKEE, ILLINOIS

Westinghouse

"Miracle Mile" Quality

BRIDGEPORT HELPS WESTINGHOUSE PRODUCE ADVANCED RADIOS AT THE FAMOUS METUCHEN PLANT

Incredibly complex machines . . . over 10 acres of electronic "day-after-tomorrow" manufacturing equipment . . . a production line over a mile long . . . combine to produce PRECISION-EERED television and radios like the models shown above! The last word in quality!

Bridgeport does their part — on advanced machinery and with modern production methods— to mold some of the intricate, durable plastic cabinets that play a role in Westinghouse performance. Not a step has been spared to make Westinghouse quality supreme in the industry.

Perhaps Bridgeport can help you produce superior products, too.

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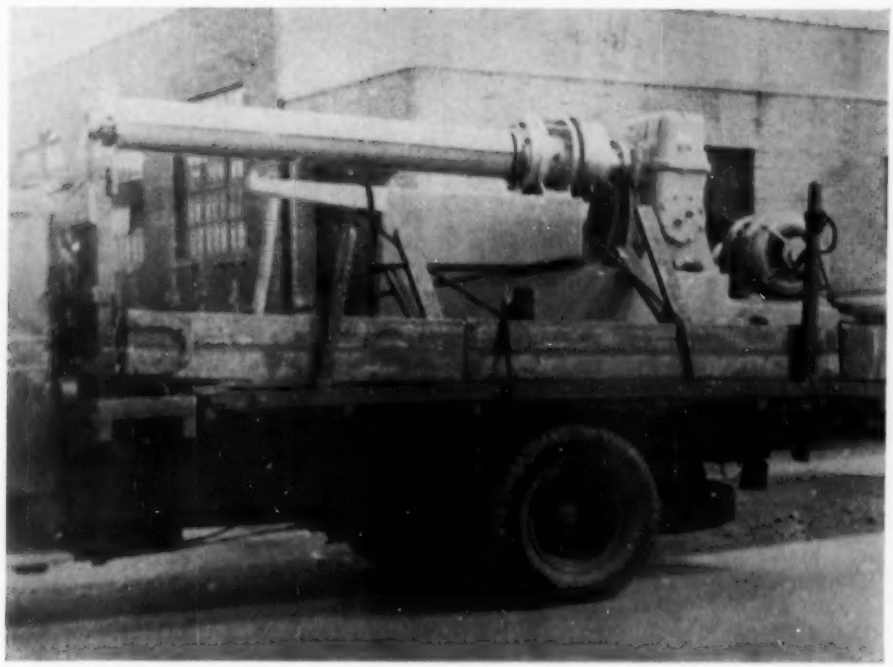

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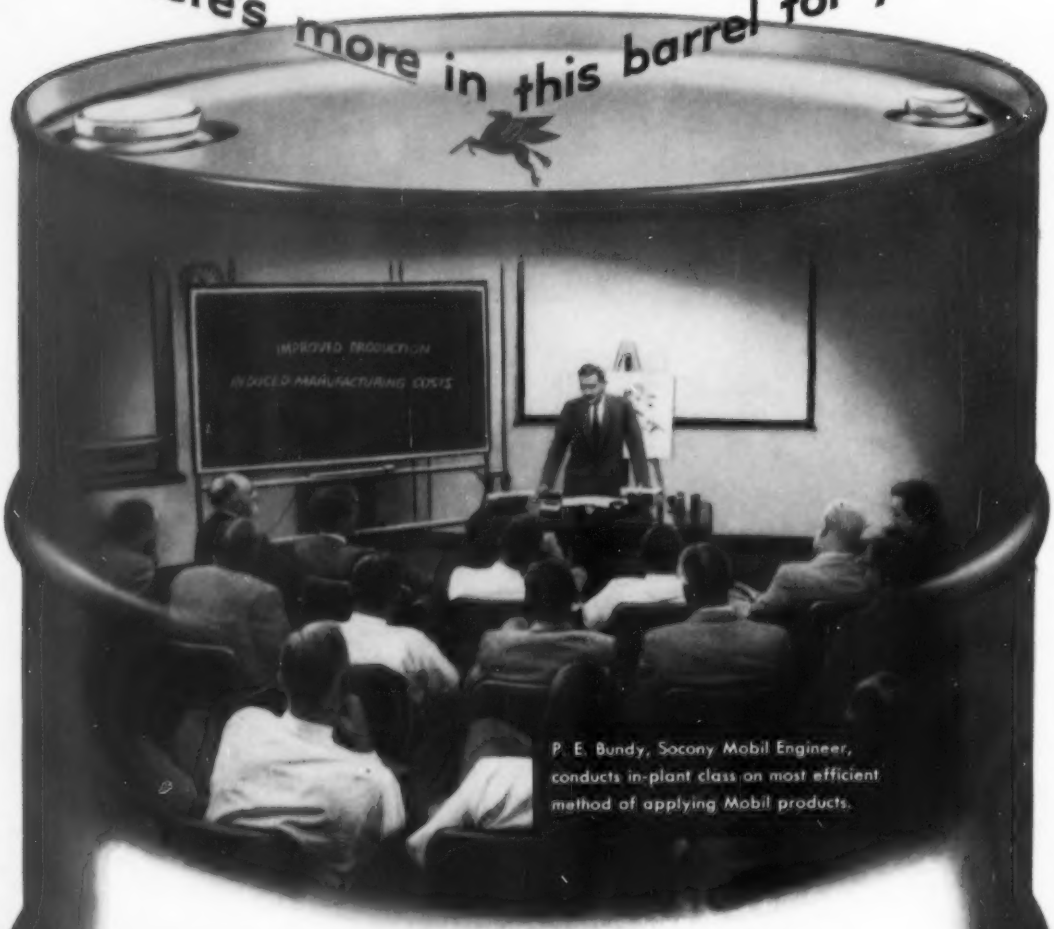

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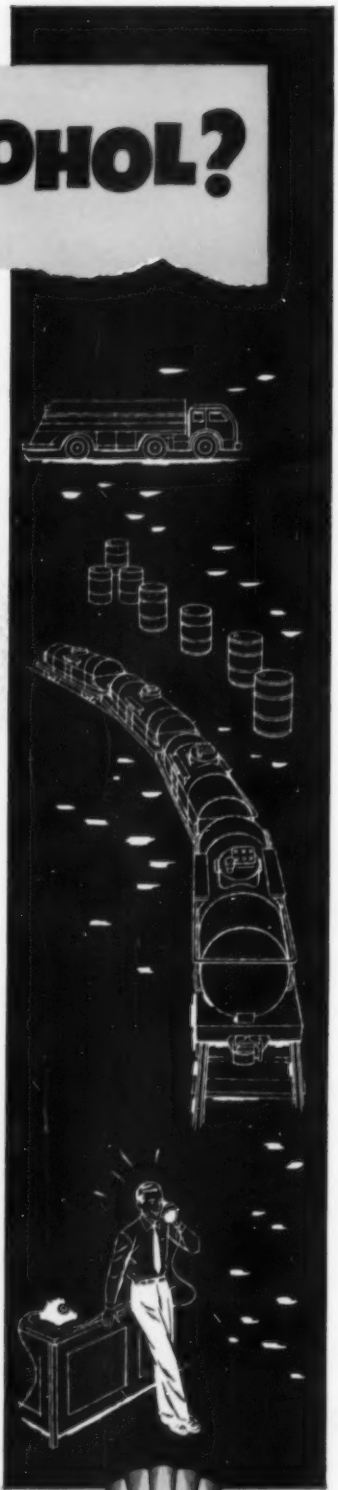

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The Plastiscope

News and interpretations of the news By R. L. Van Boskirk

Section 1

New additions to styrene family. The Dow Chemical Co. has added four new formulations to its Styron polystyrene line. The company now has 11 different formulations, each tailored to meet a specific market need. Styron 655 is a new general-purpose extrusion material with a relatively high heat distortion temperature. After extrusion it exhibits great resistance to shattering or cracking when cut off to desired lengths. It is being promoted for extruded shapes used in displays or lighting fixtures and also for bristles. Dow also suggests it as a thin film material but gives no further enlightenment on that interesting possibility. Styron 689, another general-purpose molding compound, is for use when thin sections, deep draws, and accurate dimensional control are needed. Packaging, vials, and certain housewares are examples. It is a particularly easy flowing compound designed for high-speed production of large-area parts. The material is claimed to have an unusually high heat distortion point compared to other polystyrene formulations with equivalent flow properties.

High-impact styrene molding material. Dow's new Styron 440, it is claimed, retains high-impact properties with a heat distortion over 200° F. and that is the first time that such a combination of heat resistance, impact strength, finish, and moldability have been available in one formulation. Previously, heat distortion was sacrificed for high strength. The material can broaden the base for polystyrene in such fields as radio cabinets, cutlery handles, calculator housings, and automotive, refrigeration, and photographic parts.

High-impact sheet. Dow's fourth new formulation, Styron 429, gives improved finish and gloss to sheet products, but even more interesting is its increased flexural strength; that is, it can be bent farther and more often than older formulations and still retain its rigidity. It can be used for thin wall containers and some inside refrigerator structures. Its increased flexural strength should prove advantageous in vacuum forming and should greatly broaden the market for impact styrene sheet which up to now has been primarily in refrigeration. In fact, all four of the new formulations are intended to create new markets or broaden the old ones for polystyrene. Whether or not they will cut into the volume of Dow's older formulations is still unknown, but the primary purpose is to make polystyrene more useful for more things. There is no premium price for the new formulations, but all Styron virgin compounds have recently been raised 1½¢ a pound.

New silicone plant in operation. Several units of the new Long Reach, W. Va., plant of the Silicones Div., Union Carbide and Carbon Corp., are now in operation; 171 persons are presently employed—total will eventually be about 360. The company's original plant at Tonawanda, N. Y., will continue in operation.

That 3½ billion-lb. year. In January, MODERN PLASTICS estimated that 1955 consumption of cellulosics and synthetic resins would reach 3½ billion lb. or more. Official U. S. Tariff Commission figures recently published show a 3.3 billion-lb. figure for sales, but MODERN PLASTICS always uses certain production figures in the "sales" or consumption column. Those

*Reg. U.S. Pat. Off.

are for phenolic laminates, alkyd resins, and rosin modifications. The reason is that most of the difference between production and sales for these materials is captive and used by the company which produces it. When such an adjustment is made, the consumption figure for 1955 is just short of 3½ billion lb. or a 25% increase over 1954. If the alkyds and rosins are left entirely out of the calculations for both years, the increase for synthetic resins in 1955 over 1954 was 30 percent.

Speaking of percentages. Since use of plastics increased 25 to 30% in 1955 over 1954, it is interesting to compare that growth with some other percentages. Here are a few of them: steel sales, up 35%; world rubber production, 20; die casting sales, 40% over record year of 1953; copper output in U. S., 19; rayon production, 15.6; diamond sales, 10 to 20; hardwood flooring sales, 11; aluminum, U. S. production, 7.2; piano sales, 18.7; life insurance sales, 4; major appliance items, 22; mobile homes (trailers), 34; food sales, 5.4; men's suits output, 10; machine tool orders, 70; shoe sales, 10.1; autos, 44; and toilet goods sales, 10. Cigar sales were $562 million in 1955; $550 million in 1954. All these figures were picked at random from the daily press. No pattern is intended, but it seems that 1955 was a good year to be in most any business!

Vinyls lead all synthetics. The official Tariff Commission figures show vinyls as the largest volume plastic in 1955 with 664 million pounds. Of that amount, 527 million lb. was vinyl chloride—the balance was acetate, saran, butyral, alcohol, and formal. Styrene-type resins were 559 million; phenolics, 471 million; and polyethylene, 345 million pounds. But polyethylene production was 420 million lb.; the difference is difficult to interpret. Perhaps the new producers had difficulty in moving their initial production, but none of them would admit it.

Skirmishes preparatory to battle for foam market. The Du Pont announcement that its new isocyanate plant is in production, together with a price reduction, is perhaps the first big wallop in the coming battle between isocyanate, vinyl, and rubber for the flexible foam market. Mobay and Allied Chemical soon followed with statements that their isocyanate plants would soon be in production. Du Pont reduced the price of isocyanate from $1.20 to $1.05 a lb. for those types used in foam. A customer may have his choice, depending upon reaction rate, compression strength, density desired, etc. Isocyanates of other types not used in foam (except structural aircraft parts) are now $1.15 a pound. It is only a matter of time until the price for Du Pont's Hylene isocyanate will probably be under $1.00. Polyurethane is made from an adipic acid-type polyester and isocyanate in a 75-25% combination. The polyester is now selling for about 50 cents. The basic raw materials for a 3-lb. finished polyurethane foam now costs a minimum of $1.90 per cu. ft., but the foam processor must of course charge for production, sales, and development. It's not impossible to believe that a day will come when isocyanate will drop to 70¢ and an even lighter weight foam at a correspondingly lower price will be available.

Polyether foam. Another potent angle of the foam business is Du Pont's polyether foam with a "rubbery" feeling. The company has made no public announcement of this material's potentialities nor its possible cost, but use of a polyether instead of a polyester could make a vast difference in the end product.

Elastomeric vinyl foam prices. The vinyl plastisol resin from which elastomeric foam is produced is now 30¢ a pound. Plasticizers used with it are about the same price. The compound is about 50% of each and normally sells for 35 to 40¢ a pound. Today it is generally used in a 6-lb./cu. ft. weight or more. Thus a 6-lb. vinyl would have to compete with a 3-lb. urethane, say the latter's boosters, and by this type of figuring the price differential is somewhat in favor of urethane. But the vinyl boosters maintain that lighter weight vinyl foams will eventually come to market and will be capable of competing pound for

pound with urethane in both properties and price. They further state that a 10 to 20% waste in processing will also raise the cost of urethane; waste in vinyl foam is only nominal. There are many other angles in this picture, such as the further development of chemically-blown vinyl. And, of course, there is the upholstery type of rubber latex foam, the price of which today is roughly equivalent to a 3½-lb. urethane. Developers of all three types claim that each foam will find its own market, but they are certainly eyeing each other for competitive advantages.

Which goes where? Advocates of each type of foam or sponge console themselves with the hope that each type will find its own market. Rubber foam producers insist that only their product is suitable for molding and is thus the only practical material for upholstery cushioning. Rubber foam is also used for mattresses and pillows but has by no means stolen the complete market. Total capacity for rubber foam is thought to be 300 million lb. a year—use in 1955 was about 250 million pounds. Urethane and vinyl foam producers are cautious about claiming either of the above markets until certain technical problems are overcome but certainly expect a part of the upholstery market at some future date when more material is available. Differences of opinion about compression set, aging, high- or low-temperature resistance further enliven the controversy over which is best for upholstery. Urethane is currently moving for crash pads, in cleaning or bath sponges, and in the apparel field as shoulder pads, inner lining for jackets, etc. It has made progress, but slowly, as an underlay for rugs. Vinyl foam is being used on auto visors, novelties, belts, handbags, etc., where its heat sealability, which makes possible decorative or quilting effects, is advantageous. Vinyl sponge is used for athletic mats and pads, clothing for cold weather, and life savers on boats. There are many markets—many possibilities. One producer says: "Never before in my experience has so much money been spent for a material about which there is so much uncertainty, but no one dares to ignore it for fear his competitor will come up with something good."

Chemically-blown vinyl chloride foam. Most of the talk about vinyl foam today centers about the mechanically-blown Elastomer or Dennis processes. But Foam King, Inc., has now set up a manufacturing plant at 1816 Boston Rd., Bronx 60, N. Y., to produce both open (inter-connecting cells) and closed (unicellular) cell foam at atmospheric pressure. The process uses a prepared plastisol containing a chemical blowing agent such as Du Pont's BL-33 which decomposes, leaving small gas pockets. The mass is then fused at approximately 350° F. Molded products or slabs can be stored in the unfused state. Foam King claims its method is low in production cost and that its two new types of vinyl chloride resins practically guarantees uniformity of finished foams. It also claims that its method for foaming takes 10% less time than other methods. The process is being offered on a license basis for use of the Foam King plastisol and foam manufacturing technique or for manufacture of the basic plastisol.

New plant for foam. Nopco Chemical Co. has a new plant under construction in North Arlington, N. J., for the manufacture of various plastics foams. Production facilities have been designed for 3 million tons a year of flexible and rigid urethane and vinyl foams and foamed-in-place Lockfoam. The building will be ready for occupancy in mid-1956. Nopco has also announced a new means of making profile cuttings from slabs of urethane with a "hot wire." This simple method permits fabrication of items that were formerly molded. For example, padding can be cut in one piece and in one operation to fit any size or shape. Backs and sides for molded form chairs and seat cushions can be handled with the "hot wire."

Foam versus sponge. Industrialists concerned with vinyl chloride developments like to point out that there may be considerable difference between vinyl foam and vinyl sponge. The former is mechanically blown with gas. Sponge is chemically blown and may be either open or closed cell. The latter is particularly adaptable for flotation or thermal insulation applications. Its use for impact cushioning, as differentiated from upholstery cushioning,

is just beginning. Impact cushioning is used for crash pads and packaging. The raw material costs for a 2-lb. vinyl sponge could be about 80¢ a cu. ft., which is lower than wood. Potential market cannot be estimated yet, but is big enough to excite unusual interest.

Porous vinyl. B. F. Goodrich Co. reports newly increased capacity for its Air Porous coated vinyl fabric introduced last summer. Air Porous is claimed to be different from all other breathable vinyls in that it is of cellular construction and the cells are so small that water cannot penetrate, yet its porosity is such that air can circulate freely and thus make the material more suitable for deep spring upholstery in furniture and automobiles. Even though a bit more costly than conventional coated fabric, price is no problem for Air Porous since it is built to compete with more costly fabrics and leathers. Development of this porous vinyl may well become a prominent marker in the continued expansion of vinyl markets. There is an estimated 20 yd. of upholstery used in each of the living rooms of this country's 50 million homes. It is replaced about every 10 years. If plastics can get just 1%, it will be a good market. Great new quantities of vinyl upholstery for the home seem a cinch in the next few years. The Vinyl Fabrics Institute predicts a 25 to 30% increase for vinyl-coated fabric in 1956 over 1955. If living room upholstery gets even a partial vinyl treatment, that percentage could continue to climb over a long period of years.

B. F. Goodrich Chemical Co. announces second expansion. An expansion program involving an expenditure of $8 million at Avon Lake, Ohio, has just been announced by Goodrich Chemical. With a previously announced $5 million program, the total amounts to $13 million for new facilities now building or to be built over a two year period. About $10 million of the $13 million is for vinyl. The Avon Lake facilities will be almost doubled to include vinyl compounding facilities and increased plastisol production. Other facilities at Louisville and the Harmon Color Works get the balance of the investment. Hycar rubber and Goodrite resins are included in the expansion program.

Vinyl-coated tarpaulins. One of the most active fields for vinyl plastisols today is coating nylon for use as tarpaulins. It is almost impossible to keep up with this growing application. The field has been previously served by canvas, coated canvas, and neoprene-coated materials, including glass fabric. New tarpaulins have been produced for baseball diamonds at Houston, Texas, and several major league farm team diamonds; one is expected soon to replace a neoprene-coated glass fabric cover on a major league field and another is reported to have been ordered for the Cleveland Browns' football gridiron. The same type of coated material is also moving rapidly into the home swimming pool market. Tent theaters are employing the material and circus tents are not beyond probability. Perhaps the biggest use will be for cargo covers on trucks where one man can handle the lightweight vinyl-coated nylon covering. Herculite Protective Fabrics, one of the processors in the field, says that 70% of the present uses of canvas will convert to the nylon-vinyl combination within five years.

Bakelite announces roll patent plastic. What is asserted to be the first vinyl patent sheet to be produced in continuous rolls in the United States has been announced by Bakelite Co., a Div. of Union Carbide and Carbon Corp. Made of high-gloss Krene, this material is being sold to the trade for ladies' handbags and fashion accessories by Fabric Leather Corp., New York City. Particularly notable for a dry surface that makes it more comfortable for use in either hot or cold climates, it is available in 16-, 13-, and 20-mil thicknesses in 60-yd. rolls, 48 in. wide. Continuous lengths were formerly available only from Europe.

Lower-cost itaconic acid. New price schedules of 44¢ a lb. for technical grade and 54¢ for the purified grade of itaconic acid have been announced by Chas. Pfizer & Co., Inc. The technical grade is something new; it is aimed at broadening the market for itaconic acid

(*To page 39*)

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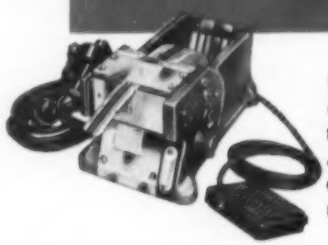

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which is named as a vital constituent in some 60 patents covering paints, plastics, resins, cellophane, etc. Two new itaconic esters—diallyl itaconate and monoallyl itaconate—are useful as monomers for plastics manufacture and as plasticizers for plastisols. Objects molded from plastisols prepared with these esters may be converted into hard, rigid materials by suitable curing. Diallyl itaconate also can be used as a cross-linking agent for polyester resins.

Polyvinyl acetate paint possibilities. A. W. Dunning, director of marketing for Shawinigan Resins Corp., says: "It is our feeling that the market for PVAc paints has just begun to rise and sales should hit about 15 million gal. by the end of this year—almost double 1955 sales . . . PVAc paints will not replace other latex paint systems . . . each such system will seek its own level."

Pearlescent cast methacrylate sheet. Cadillac Plastic & Chemical Co., Detroit, Mich., is now on the list of producers who manufacture pearlescent cast methacrylate sheet. Available in more than 20 colors, in thicknesses from 0.080 to 0.250 in., sheet sizes range from 12 by 48 to 36 by 48 inches.

Non-toxic stabilizers. Ferro Chemical Corp. states that the U. S. Food and Drug Administration has approved two new Ferro non-toxic stabilizers, which are claimed to be the first non-toxic, high-temperature resistant stabilizers cleared for use in vinyl food wrapping. Labeled 707X and 760X, they prevent discoloration of vinyl film by the hydrochloric acid released during processing.

Methacrylate gets into polyester business. An acrylic (methacrylate) modified polyester resin is being used by International Molded Plastics, Inc., Cleveland, Ohio, for its new Structoglas A press-molded reinforced plastics building panels. The new resins are claimed to have more than twice the inherent color stability, to support up to 100% more weight per sq. ft., and to have 2.23 times greater weather resistance than conventional polyesters. Methacrylate was destined to get into this field sooner or later because of properties which are peculiarly fitted for the job—especially its weathering properties which are generally considered to be the best of all common thermoplastics. This could be the beginning of an added upsurge in the use of fibrous glass-reinforced panels for both exterior and interior uses in residential, commercial, institutional, and industrial buildings.

Polyethylene in India. Imperial Chemical Industries, Inc., England, has received approval from the government of India to build a polyethylene plant in that country. Manufacture will be undertaken by an I.C.I. associate, Alkali and Chemical Corp. of India, Ltd., in which the Indian public holds a substantial interest. Investment will involve over $6 million. I.C.I. (India), Ltd. has operated a polyethylene film plant in Calcutta since 1953.

Another type fibrous glass panel. Another way of producing better fibrous glass-reinforced plastics panels is announced by the Corrulux Div., L-O-F Glass Fibers Co. Introduced as Granitized Corrulux, the new material has a surface evenly sparkled with

minute facets of polyester which protect the fibrous glass reinforcements more thoroughly than in conventional materials. The process does not involve coating or glazing; it molecularly bonds the resins over the fibers and throughout the panel. The big over-all improvement is that the Granitized surface resists erosion, a major problem in fibrous glass panels.

More resin for wood. U. S. Plywood Corp. has acquired Youngs Bay Lumber Co., Roseburg, Ore., and plans to construct new plywood and Novoply plants there. The new plywood plant will have an initial annual capacity of approximately 75 million feet. No figures have been released on how much of this will be exterior grade plywood which requires phenolic resin, but the over-all industry percentage for exterior grade is steadily increasing. Few persons would have guessed that the peak of nearly 40 million lb. of solid phenolic resin reached during the Korean war would ever be surpassed, but the 1955 production total was over 44 million lb. and the plywood industry has found ways to minimize a feared shortage of peeler logs that once threatened to curtail production. A 50 million-lb. phenolic resin goal for this purpose in the near future is no longer just a dream.

New name for polyethylene. The effort to find a new name for polyethylene that is more fitting than high or low pressure, high or low density, linear, etc., is beginning to pay off. Producers are starting to use the term "olefin resins." Such a designation covers both old and new type polyethylenes, as well as the soon-to-come olefin petrochemicals such as propylene which are expected to develop from the new Ziegler and Phillips catalyst methods. The various olefins will probably be designated by type, letter, or number. Campaigns to boost the use of the new designation will soon start; some producers, notably Kellogg and Celanese, are already using it.

New polyethylene film plant in Canada. Canadian Resins and Chemicals, Ltd. is building a new plant at Ste. Therese, Que., for production of polyethylene film and tubing. The plant will have three production lines; present schedule calls for full production within six months. The company now produces cast vinyl film, planished elastomeric and rigid Vinylite sheets, and calendered Vinylite film and sheeting.

Southeast Texas gets another polyethylene plant. The Texas Gulf Coast is likely to be "drowned" in polyethylene if the present trend continues. Latest to announce construction of a polyethylene plant in the Houston area is Celanese, with a new 40 million-lb. plant for manufacture of Phillips-type "low-pressure" olefin on a 220-acre site south of San Jacinto Park. Construction is scheduled for completion during the first quarter of 1957.

Plastic plants in Spain. Monsanto Chemical has made an agreement providing for acquisition of an equity in Etino-Quimica S.A., Barcelona, Spain, in return for the investment of machinery, equipment, and technological aid. The Spanish company presently has a polyvinyl chloride plant at Monzon. Agreement with Monsanto provides for expansion of P.V.C. facilities and the building of polystyrene production facilities. The Spanish company was originally formed by Hidro-Nitro Espanola, S.A., an electrical manufacturing organization, and Aiscondel, S.A., a molding and calendering firm.

Formaldehyde expansion. Spencer Chemical Co. has announced a $120,000 expansion of its formaldehyde capacity at Calumet City, Ind. The expansion represents a 25% increase and will be completed by Jan. 1, 1957.

Peracetic acid. Carbide and Carbon, a Div. of Union Carbide, has developed a new source and new methods for producing peracetic acid from which a family of olefin epoxides is

expected to spring. Several years are expected to elapse before these developments reach full stature. Carbide believes that epoxides produced by the peracetic acid route will be less costly than those now being made from natural oils. Some of the new epoxides are particularly applicable to plastics in the fields of epoxy resins, plasticizers, and stabilizers. As a light stabilizer for vinyls, there is a possibility of commercial development for one that outperforms tin stabilizers—in test runs the vinyl sample was unchanged after 1750 hr. exposure. The secret is the stabilizer's ability to take up every trace of hydrochloric acid. It can be used in percentages as high as 10% of the compound. It is also a good heat stabilizer. Another possibility for future consideration is development of an epoxide for cross-linking purposes that might even make possible a thermosetting vinyl chloride resin.

Price reduction for polyvinyl alcohol. Colton Chemical Co., a Div. of Air Reduction Co., Inc., has been able to decrease prices on its Vinol polyvinyl alcohols from 1 to 9% because of increased sales and stepped-up production capacity.

Odorless plasticizers. Government agencies have accepted use of the new, odorless Citroflex A-2 as a plasticizer in synthetic film packaging materials for both fatty and non-fatty foods, according to Chas. Pfizer & Co., producer of the plasticizer. Citroflex A-2 is the trade-name for acetyl triethyl citrate, a solvent plasticizer for cellulosic plastics.

Another guess at urethane production. Polyurethane foam production should reach 100 million lb. by 1960, according to Dr. Richard B. Greene, coordinator for plastics and resins, Barrett Div., Allied Chemical & Dye Corp. He also pointed out that polyurethanes are superior adhesives and show promise of solving difficult metal-to-metal bonding problems in low-temperature applications. He forecast that future products of urethane research will be dramatically different from those now being made.

Reichhold-Catalin. After months of off-again, on-again negotiations, the Reichhold-Catalin merger now seems destined for conclusion. The merger agreement has been executed by the boards of directors of both corporations. Upon merger, Reichhold stockholders will receive 2.8 shares of the common stock of the merged company for each Reichhold share. Catalin stockholders will retain their holdings. A substantial amount of the stock to be received by Reichhold stockholders on exchange will be placed in a voting trust. The name of the surviving corporation will be Reichhold Catalin Industries, Inc. Catalin's line of liquid phenolic and urea resins is generally duplicated by Reichhold, but the latter produces phenol and formaldehyde used in the manufacture of most Catalin products. Status of Catalin's polystyrene operation has not been made known—the Catalin polymer plant was leased to Dow Chemical a year ago and Catalin became a distributor for Dow's complete line of polystyrene formulations. Reichhold has not heretofore been in any phase of the styrene operation.

Plastic shovel from gasoline. A shovel, claimed to have been made from polystyrene produced from gasoline, was used for breaking ground for Cosden Petroleum Co.'s 20 million-lb. capacity styrene plant at Big Spring, Texas. The claimed-to-be-new Cosden process cuts out a complete step in styrene production and uses new techniques for "ultra fractionation" for recovery of ethyl benzene direct from petroleum stocks. Badger Mfg. Co., Cambridge, Mass., which developed the new process jointly with Cosden, is building the plant.

Borden buys another West Coast plant. The Borden Co. has acquired the consolidated Resin Industries, Resinite Sales Corp., and Grant Chemical Co., all of which were affiliates located in Santa Barbara, Calif. Resin Industries was founded in 1944 by Grant Conklin Ehrlich who has been president and will continue as head of the consolidated organization. The company extrudes vinyl and polyethylene and was one of the first to produce vinyl garden

hose and sprinklers. Grant Chemical manufactures molding compounds and vinyl compounds for specialized extrusion. Borden is now building a 12 million-lb. vinyl chloride polymer plant in Leominster, Mass.

Improved impact phenolic. A new impact black phenolic molding compound, G-E 12906, has been announced by General Electric Co.'s Chemical Materials Dept. It is said to have an Izod impact range of .40 to .44 and to be suitable for automatic molding, even though its impact is greater than usual. The filler is wood flour and cotton flock. G-E reports that it will produce molded parts with a finish superior to that generally found with conventional impact materials in both cold powder and preheat applications.

More cast acetate. With the start of operations at the first units of Celanese's new cast sheeting plant at Belvidere, N. J., increased quantities of cellulose acetate cast sheeting in thicknesses of 0.003 to 0.020 in. and of lightweight cellulose acetate film in thicknesses of 0.0007 to 0.0200 in., are now available.

Organosol for webbing. Especially suitable for application to webbing materials used in automobile and airplane seat belts, a new organosol formulation, based on Pliovic AO, has been announced by The Goodyear Tire & Rubber Co.'s Chemical Div., Akron, Ohio. According to the company, Pliovic AO imparts high abrasion-resistance and flexibility to the coating.

New thermoset sheet. A new, clear, and almost colorless polyester sheet, called Homalite 101 and developed by The Homalite Corp., Wilmington, Del., is said to have high heat resistance and not to support combustion. Although the material chars when direct flame is applied, it will not continue to burn when the flame is removed. Homalite 101 is claimed to provide excellent scratch resistance and to be a better thermal insulator than glass. The material is available in standard size sheets approximately 24 by 30 inches.

New polystyrene supplier. Formation of Polymer Products, Inc., as a producer of polystyrene molding compounds, has been announced by Gilbert Plastics, Inc., Hillside, N. J. Polymer will supply the parent company with high- and medium-impact polystyrene in crystal and color. Gilbert also announces that specialty copolymers and styrene alloys are being developed to expand the application of low-cost plastics molding for throw-away packaging.

More capacity for Hetron. Hooker Electrochemical Co. is doubling the capacity of its Hetron polyester resin manufacturing facilities, scheduled for completion shortly. The company now has eight Hetron resins which complement uses for ordinary polyesters, thereby expanding the markets into fields where fire is a real or potential hazard. Resolite Corp. and Filon Plastics Corp. have recently announced their use of Hetron in complete new lines of fire-retardant panels which carry the Underwriters' Laboratories label.

Polyken to have new million-dollar plant. A new million-dollar plant for the manufacture of Polyken plastic film and plastic adhesive tape coatings for corrosion prevention on gas lines, metal pipe, conduit, and cable will be erected by The Kendall Co. on a 76-acre site in Franklin, Ky. The initial unit will more than triple present production capacity for Polyken polyethylene protective tapes, which in the last few years has increased 500% in volume. In recent years, Polyken engineers have extended their interest beyond the product into the design of machines for the more efficient application of the product. Today, both hand and power equipment are available for wrapping all diameters of pipe from ½ to 36 inches.

For additional and more detailed news see Section 2, starting on p. 246.

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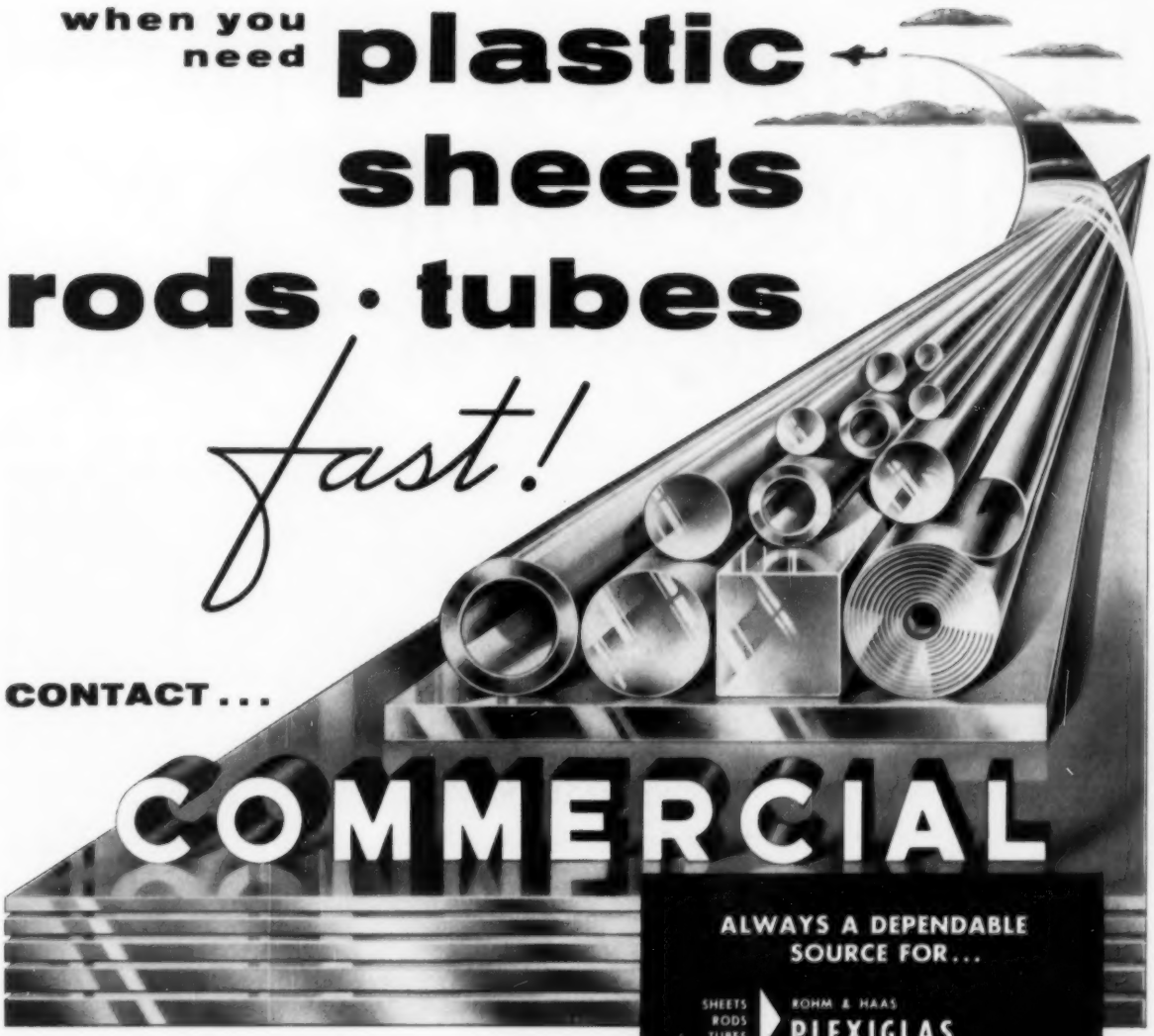

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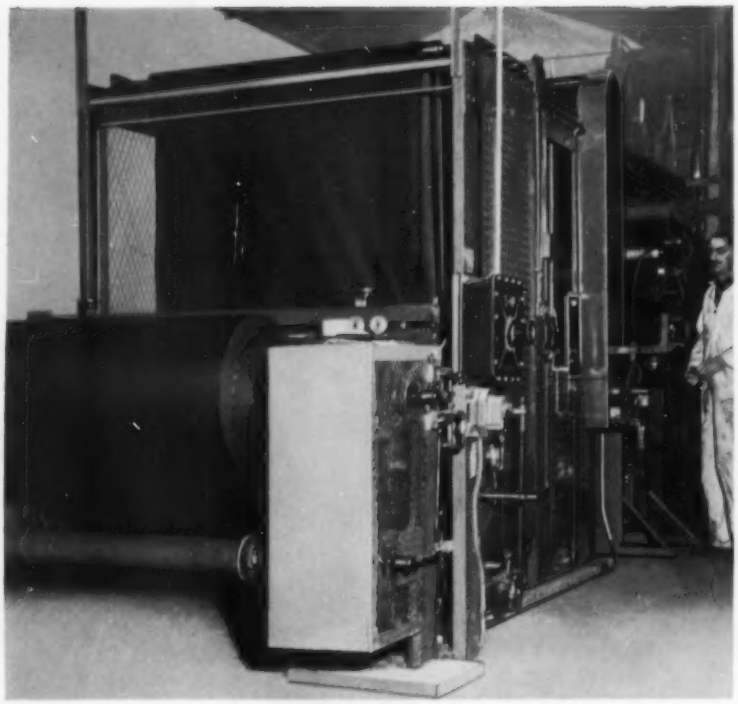

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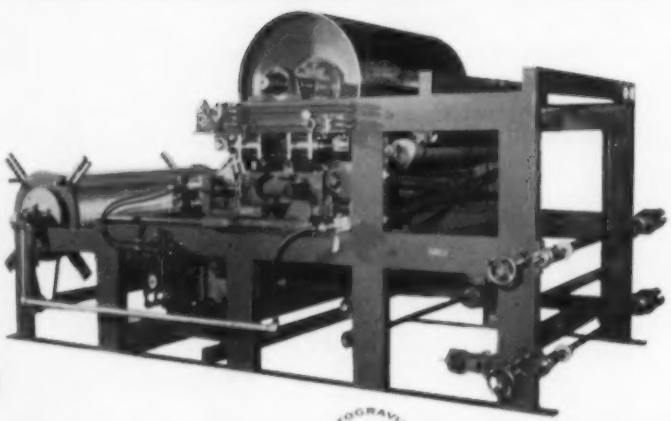

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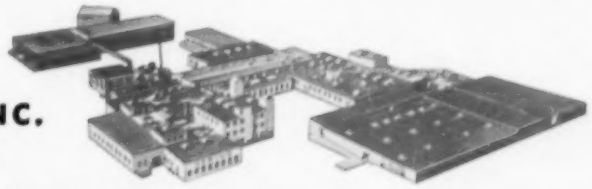

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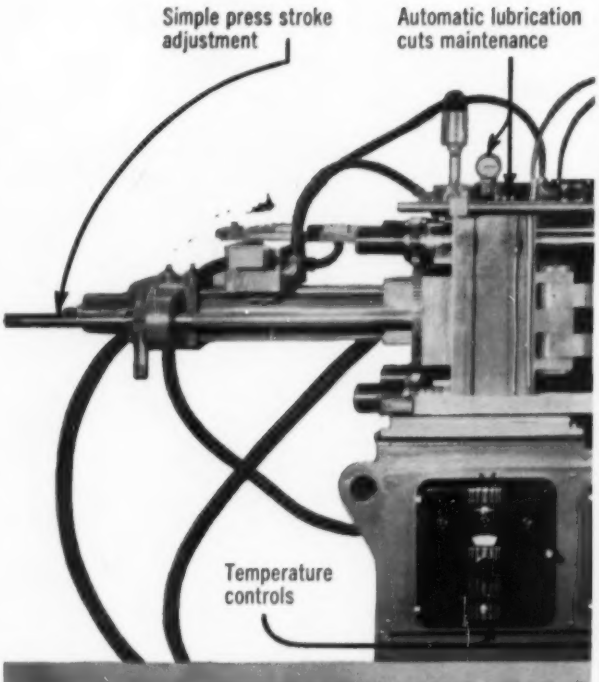

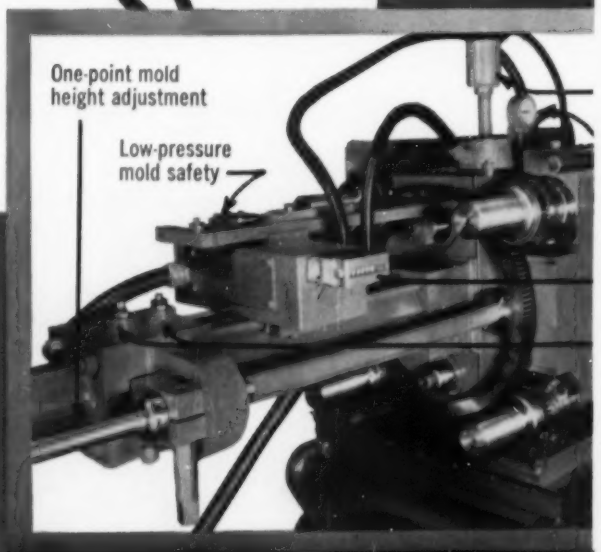

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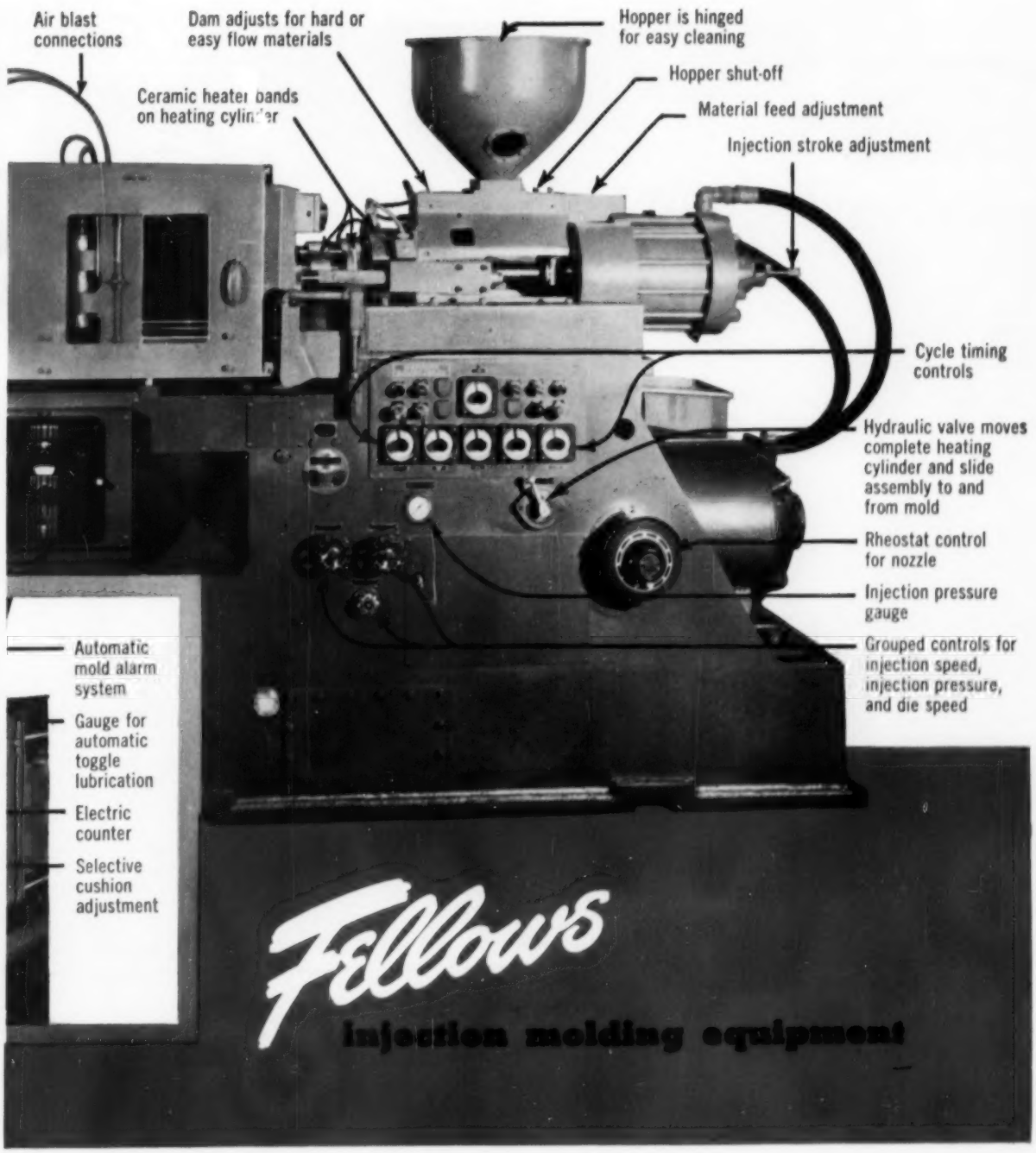
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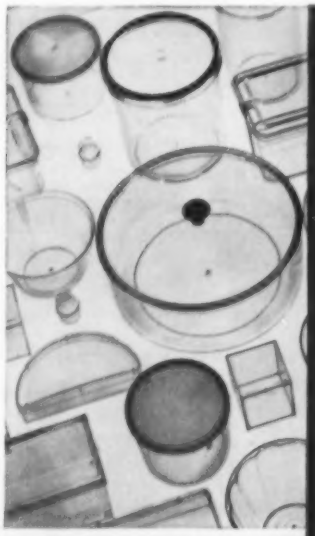
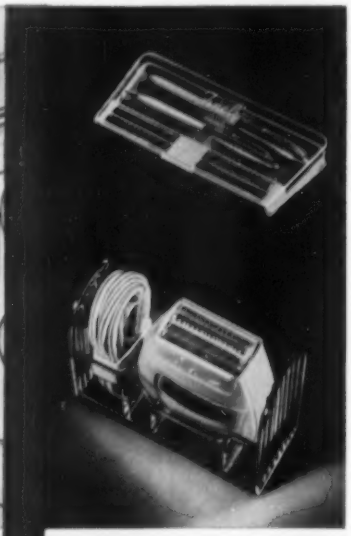
Below are typical applications of four Dylene formulations. If you would like more information about the family of Dylene polystyrenes, write to Koppers Company, Inc., Chemical Division, Dept. MP-56, Pittsburgh 19, Pennsylvania.

DYLENE 2

Outstanding flow properties of this plastic make it extremely useful in large-area, thin-section moldings. In high speed, fully automatic molding machines, Dylene 2 fills molds quickly at lower cylinder temperatures than are usually required for general purpose polystyrenes. It is used to make disposable packages, "egg crate" lighting panels, picnic spoons and tumblers.



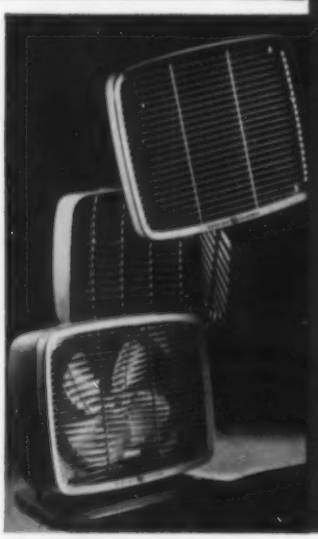


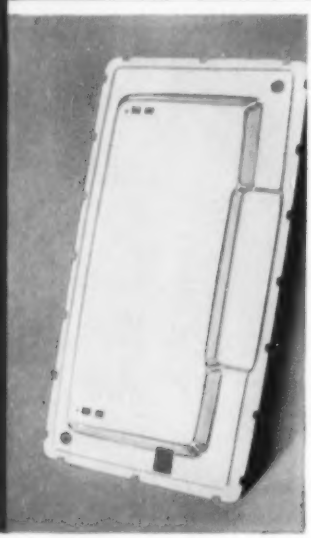
DYLENE 4

Easy flowing and fast setup characteristics make this plastic a real standout. Dylene 4 has greater strength and heat resistance than the usual easy flow polystyrenes. Result: faster cycling and ejection. This plastic is used to make combs, vials, thin-walled containers and display packaging items such as cases for pen and pencil sets and holders for electric shavers.

DYLENE 30

This medium impact polystyrene is not only easy to mold and fast to set up, but—it has a surface gloss and weld appearance that is almost indistinguishable from conventional polystyrenes. This unusual combination of properties makes this new plastic highly desirable for use in critical appliances such as air conditioner grilles, cosmetic caps and closures, housewares and toys.





DYLENE 200

Here is the easiest flowing polystyrene in the Dylene high impact line. Because of its easy molding properties, this plastic can be used in thinner sections than normal impact polystyrenes. It has excellent surface gloss and weld appearance. Dylene 200 is commonly used in refrigerator door liners, crisper trays, egg shelves, breaker strips and meat compartments, air conditioner grilles, housewares and toys.

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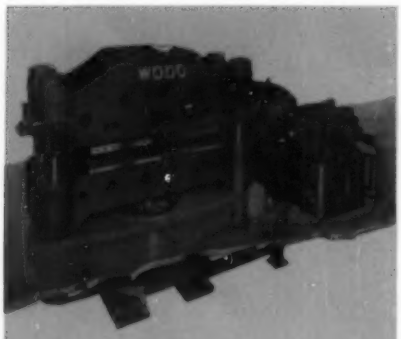

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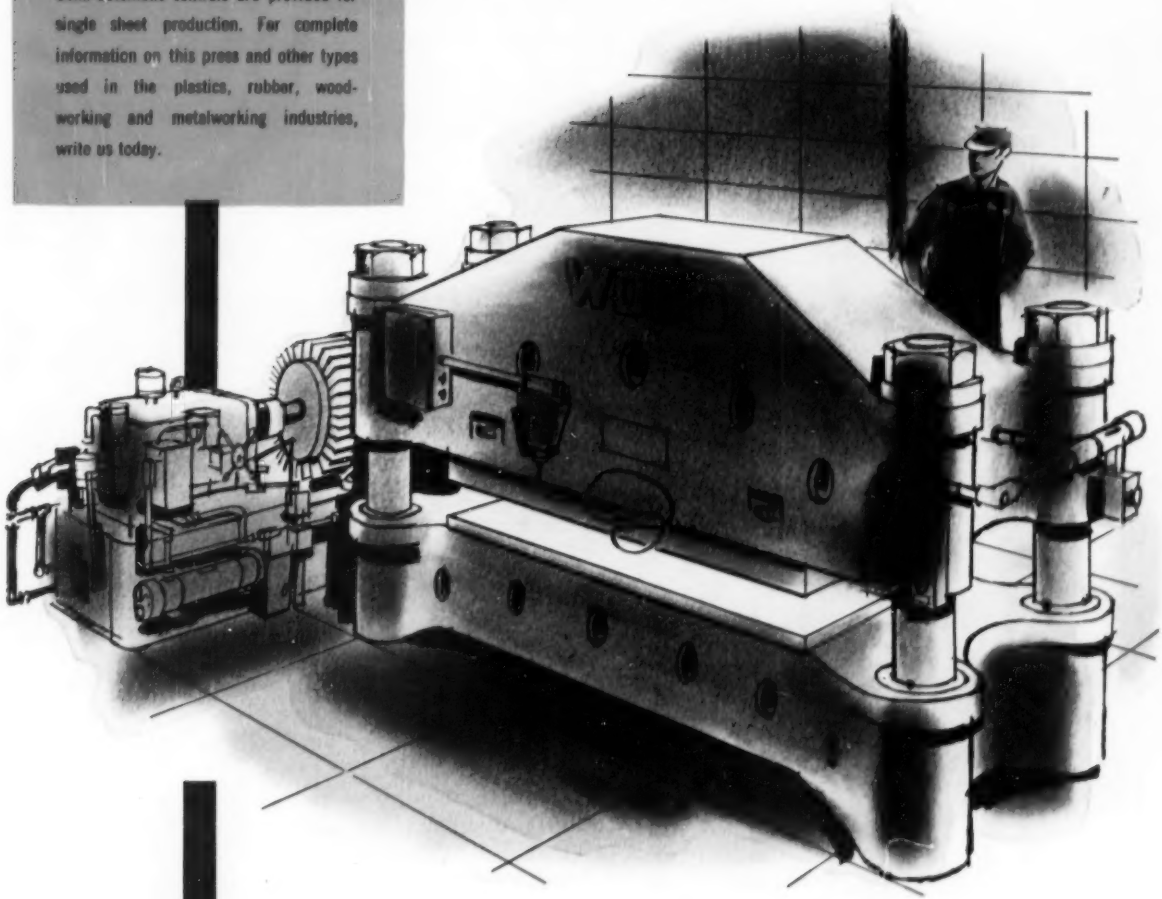

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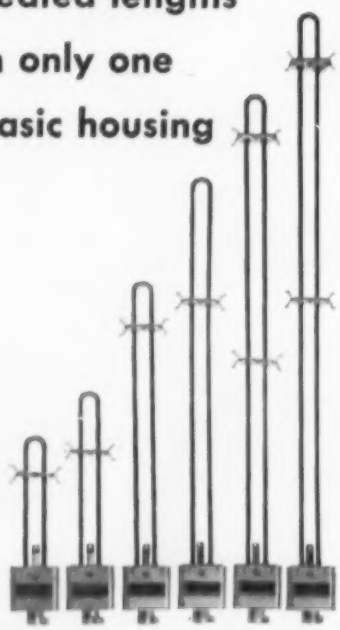

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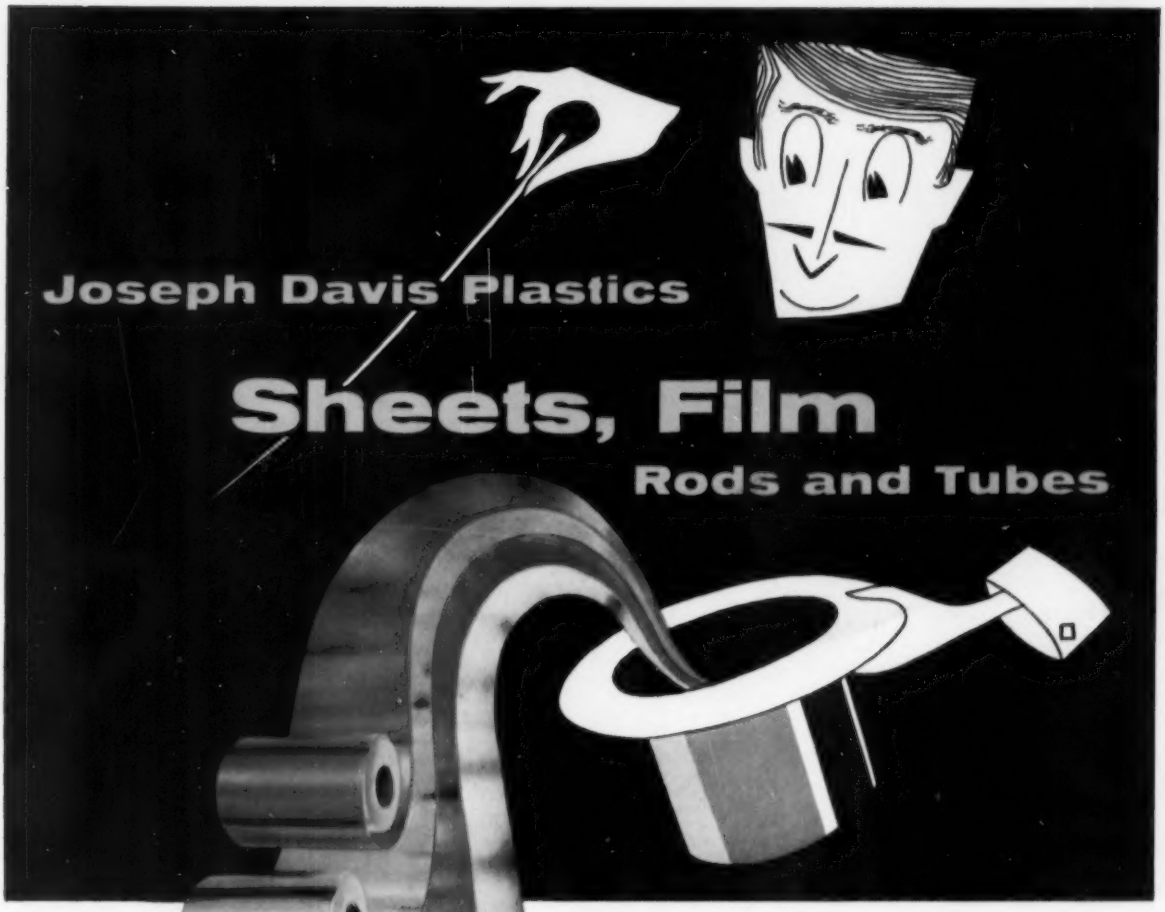

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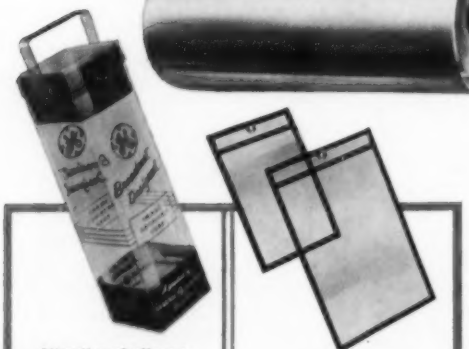

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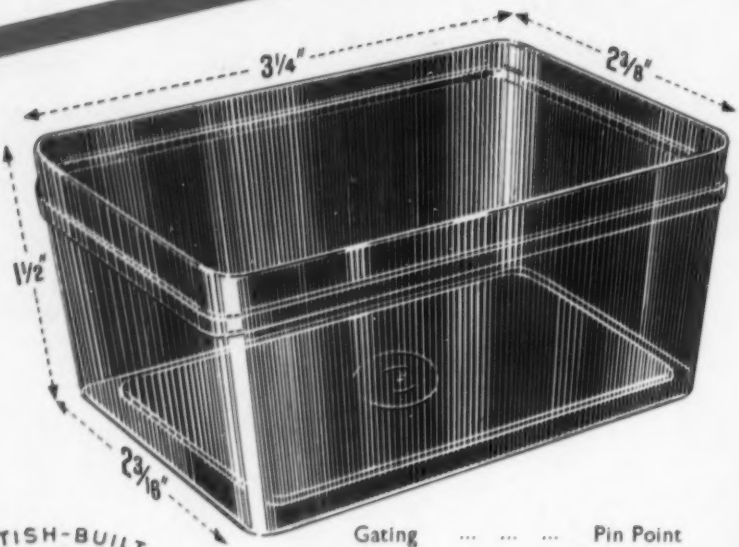

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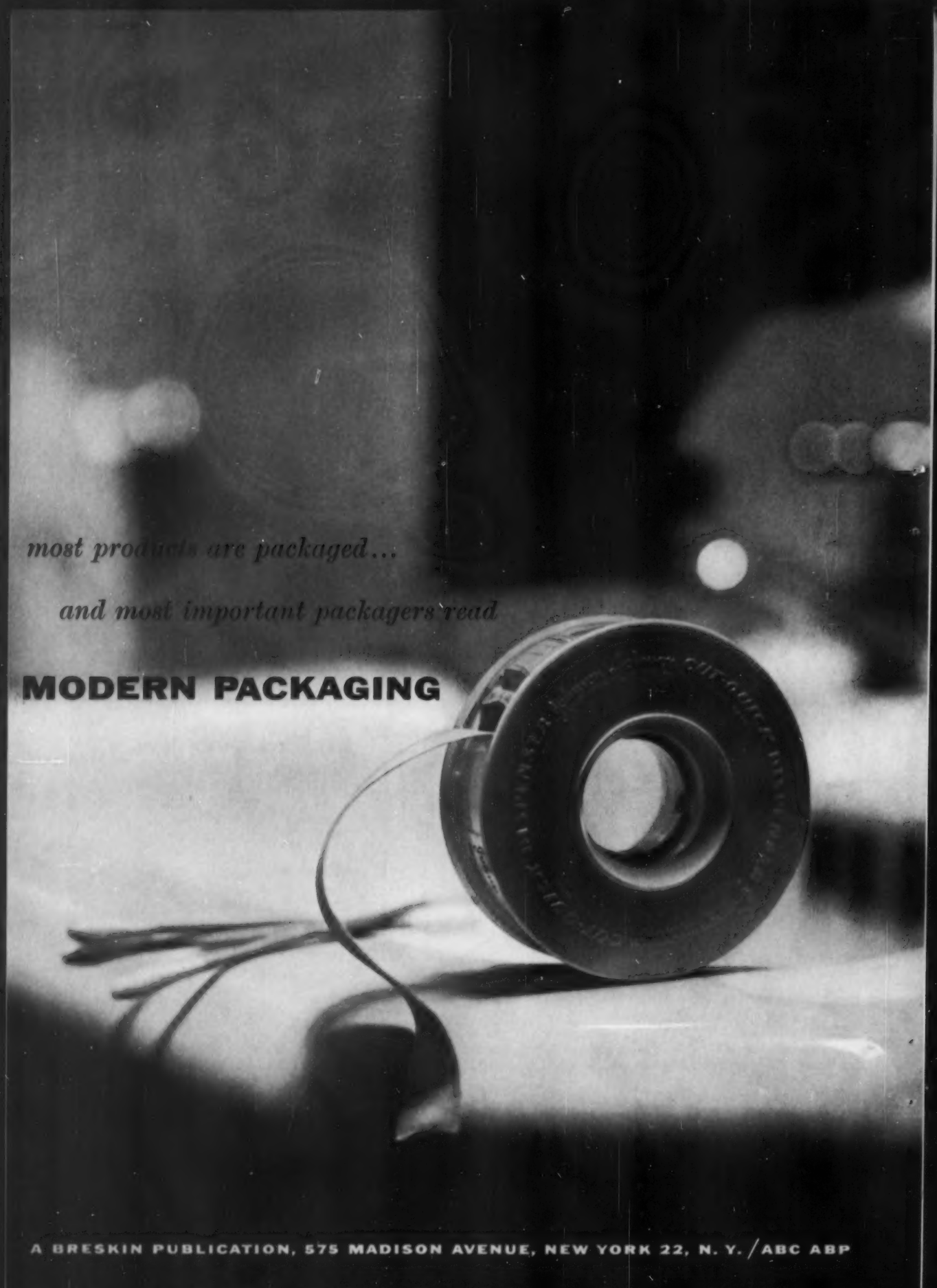
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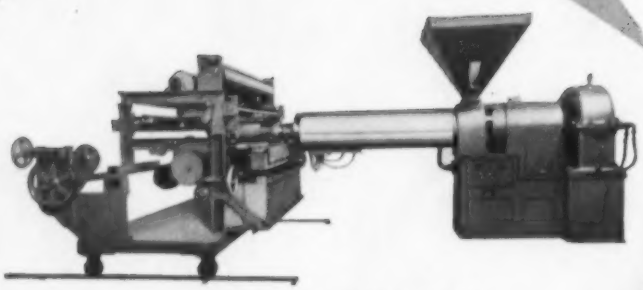

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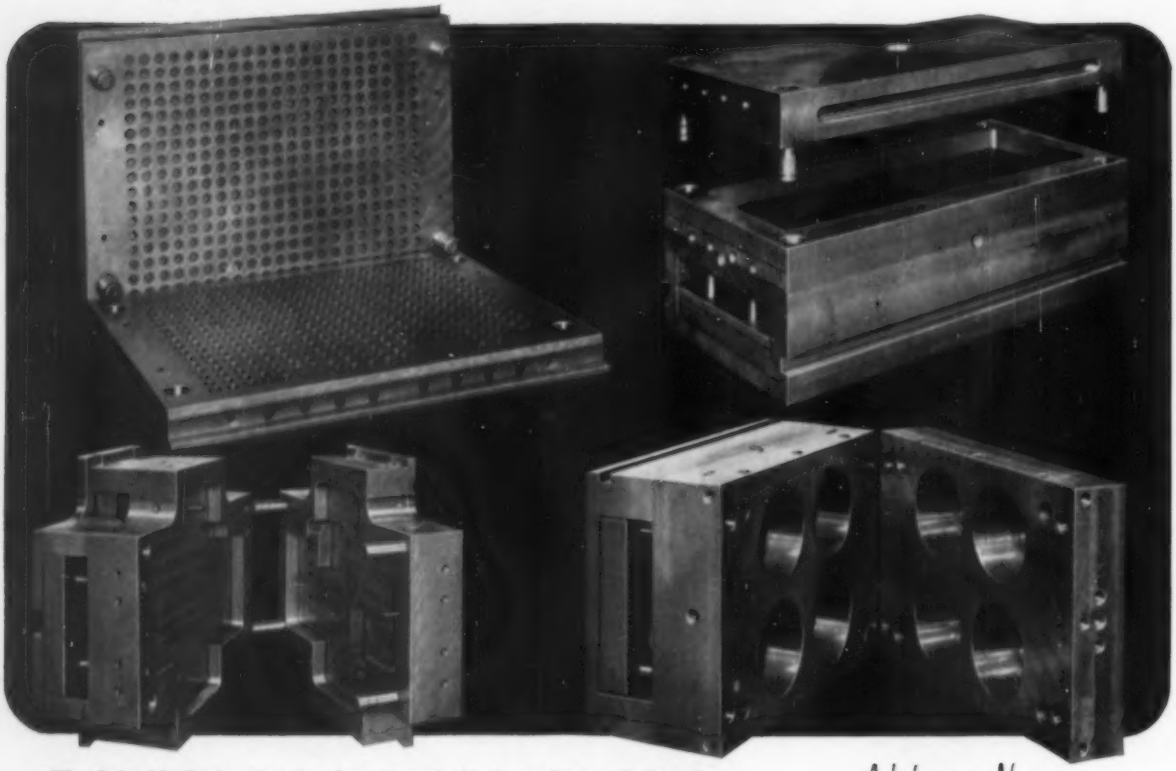

The Columbia Engineering Co., Inc., Newark, N. J., profits greatly by using Speed Treat Steel Plate in the production of their die cast die and plastic mold bases. The "Columbia line" includes custom built nested plastic mold and die cast die bases, heating and cooling platens, ground plates, support columns, pressure pads, stripper bolts, auxiliary leader pins and bushings.

Shown here are four plastic bases Columbia built of "time-saving" Speed Treat Plate. Normally the steel is used in its as-rolled state, but for long run molds where the application demands it, Speed Treat is semi-hardened to 28-32 Rockwell C.

Speed Treat Plate meets the moldmakers' requirements as to service life, ease of machining, uniform hardening and savings in tool life. High polish and low deformation under pressure make Speed Treat a favorite with moldmakers and die cast diemakers from coast to coast.

Ask for our New Speed Steel Plate Bulletins:

Bulletin 542— SPEED CASE	low carbon free machining open hearth steel plate
Bulletin 542— SPEED TREAT	medium carbon free machining open hearth steel plate
Bulletin 543— SPEED ALLOY	high quality chrome-manganese alloy steel plate

THE SPEED STEELS ARE DISTRIBUTED COAST TO COAST BY THESE WAREHOUSES

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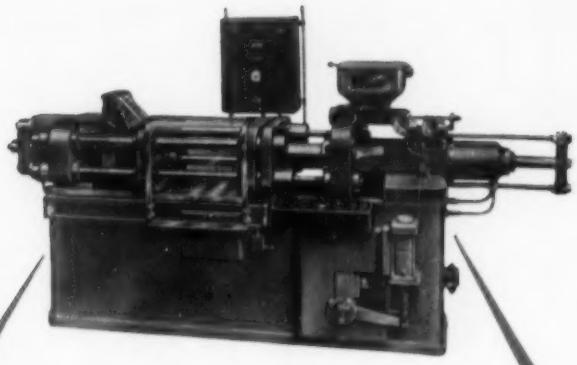
INJECTION MOULDING MACHINES

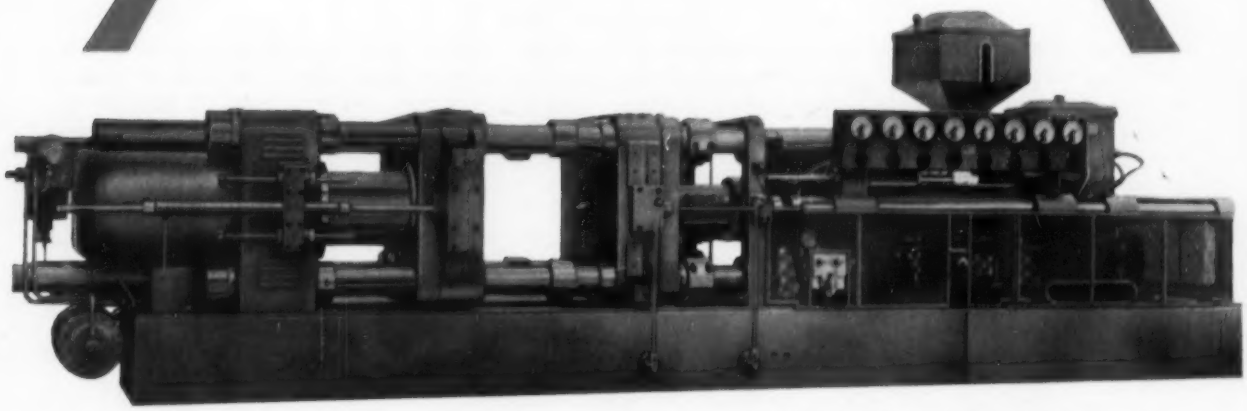
MILANO ITALY



Capacity of our range

from 2 ounces

to 215 ounces



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CABLE ADDRESS SCACCHI—Paris

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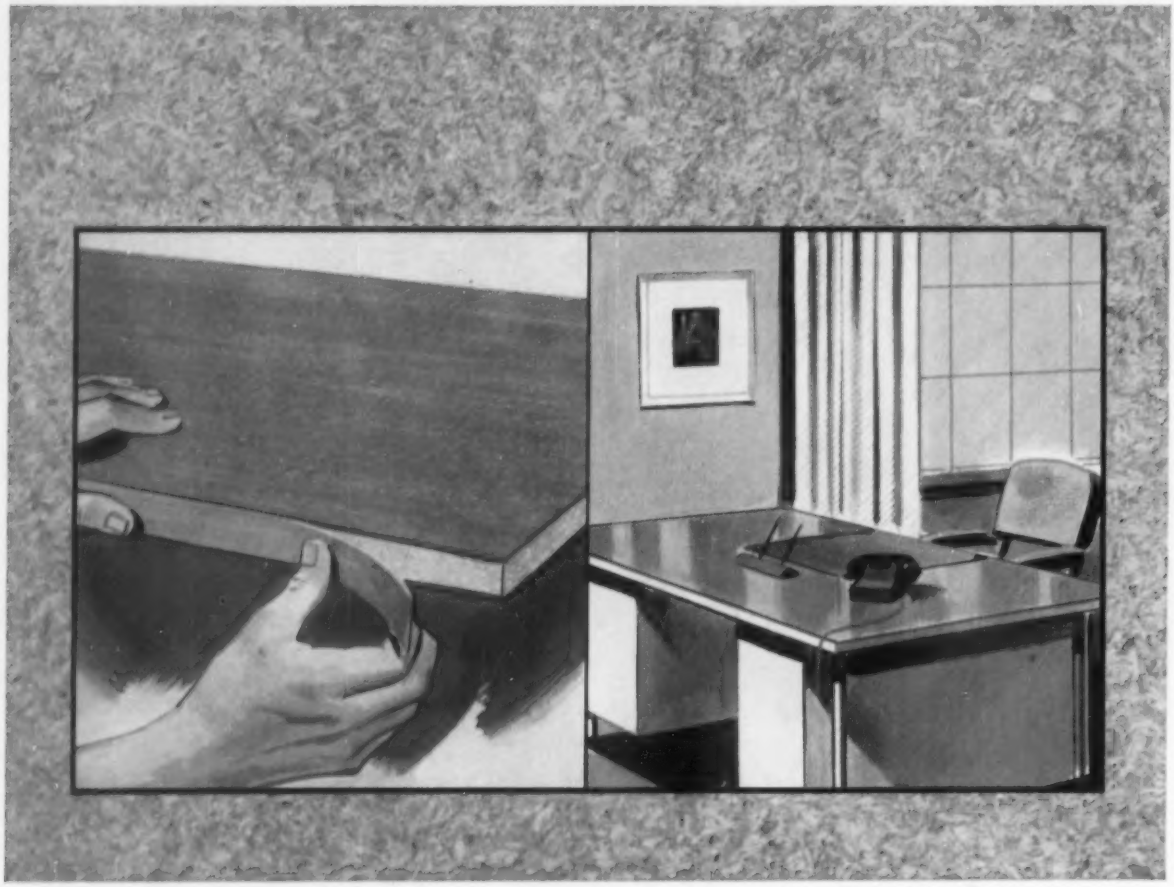


WEYERHAEUSER 4-SQUARE PARTICLE BOARD—

Offers Production Benefits plus Quality Control

IF YOU MAKE a product using decorative laminated plastics or wood veneers, here is a tip! Your product will look better on the *outside* if it has Weyerhaeuser 4-Square Particle Board on the *inside!* This new and better core stock by Weyerhaeuser gives your product added surface appeal plus structural soundness and durability because of its tensile strength, dimensional stability, flatness and smoothness. Completely free of grain and knots, it is available in densities for both 3 and 5 ply use.

These panels come to you smooth both sides, ready to glue without drying, sanding or planing. Panels, when veneered or laminated, provide outstanding machining qualities . . . can be sawed, drilled, routed or mortised. Edges may be banded with wood, metal or plastic strips. Moderate in cost, Weyerhaeuser 4-Square Particle Board is ready to help you effect better quality and cost control. You can plan production schedules in advance, counting on availability of product and stability of price.

Available in 4′x8′ panels or cut to your order size and in thicknesses of $\frac{3}{8}$″, $\frac{1}{2}$″, $\frac{5}{8}$″, $\frac{3}{4}$″, 1″.

Get the FACTS!

We'll be glad to mail you more information on the possibilities of important savings and a better product for you. Write today!

Weyerhaeuser Sales Company

DEPARTMENT PJ-56

First National Bank Building • St. Paul 1, Minnesota

Rich black leather-grain finish creates high quality package quickly at comparatively low cost.

Contoured recesses provide snug fit for cutlery.

a Perfect Case

OF HOW A PACKAGE SELLS THE PRODUCT

This silent salesman speaks for itself and tells a story of sales success:

- Tasteful design, rich finish and functional contours create a compelling display.
- Unique construction of cardboard sandwiched between two formed vinyl sheets make for greater rigidity.
- Light weight facilitates handling.
- Sturdiness insures long service.

NIXON RIGID VINYL SHEETING, proven by leading manufacturers to be particularly adaptable to new forming methods, help make these potent features possible.

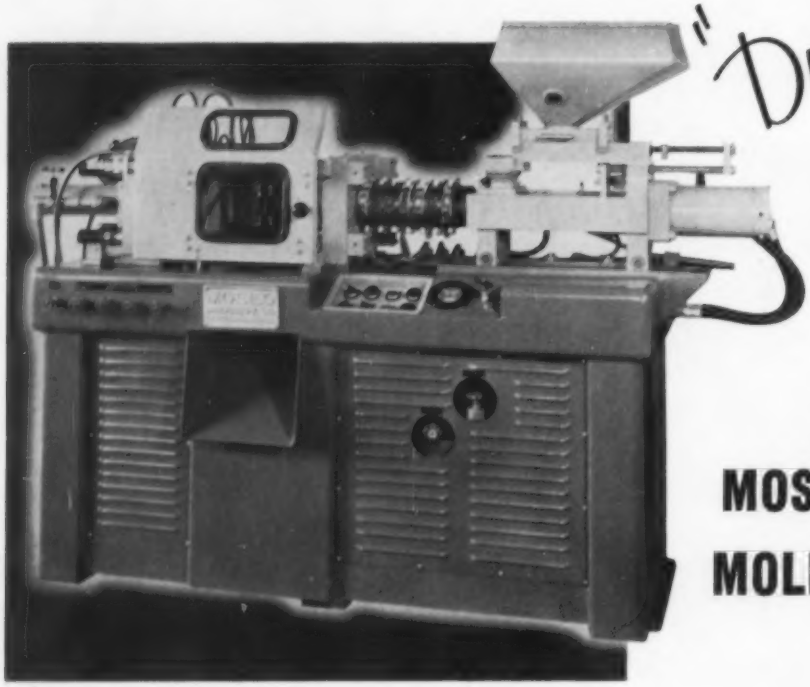
Consider how much a good basic material can do for your product, then . . . Write, phone or see Nixon, your source for *a complete line of formable sheets.*

Nixon PLASTICS

NIXON NITRATION WORKS, founded 1898, Nixon, New Jersey. Phones: New Brunswick Charter 9-1121, Metuchen Liberty 9-0200, N. Y. Ext. WOrth 4-5290. **Chicago Office,** 510 N. Dearborn St., Phone Michigan 2-2363. **St. Louis, Mo.,** C. B. Judd, 3687 Market St., Phone Lucas 8082. **Leominster, Mass.,** Phone 7-2120. **Canadian Distributor:** Crystal Glass & Plastics Ltd., 130 Queens Quay E., Toronto, Ontario.

Cases produced by automatic pressure forming, an exclusive process by Plaxall Inc., Long Island City, N. Y.

720 CONTAINERS MOLDED PER HOUR IS "Duck Soup"



WITH A MOSLO INJECTION MOLDING MACHINE

The Moslo Model 74 Super 2-ounce injection molding machine is the last word for molding containers.

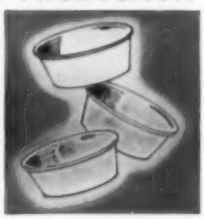
Especially designed and engineered to fit the needs of the container industry, this high-speed, fully-automatic machine will mold thin or heavy wall sections from a single or multiple cavity mold.

The best way to fully appreciate a Moslo machine is to come in for a demonstration. Bring your own molds and we will gladly show you the way to make container molding as easy as "Duck Soup".

COMPARE THIS FOR PRODUCTION

Illustrated at the right is a polystyrene dish produced on a Moslo Super 2-ounce machine. Seven hundred and twenty (720) of these 6-ounce dishes were shot per hour from a single cavity mold. Specifications are:

Wall thickness	.025"
Top diameter	4"
Bottom diameter	3.072"
Depth	1¼"
Weight	12.5 grams



The MOSLO line includes these models, ideally suited for container molding.

Model 74-7 –Super 2 ounce with 7" mold stroke
Model 74-12–Super 2 ounce with 12" mold stroke
Model 75-8 –High speed 3 ounce with 8" mold stroke
Model 75-15–High speed 3 ounce with 15" mold stroke
Model 76-8 –Super 3 ounce with 8" mold stroke
Model 76-15–Super 3 ounce with 15" mold stroke

MOLDERS SAY—SINGLE CAVITY MOLDS ARE PAYING OFF!

MOSLO MACHINERY COMPANY

2437 PROSPECT AVENUE • CLEVELAND 15, OHIO

SEE US AT THE NATIONAL PLASTICS EXPOSITION, BOOTH NOS. 628 and 632

From a modern day Aladdin's lamp

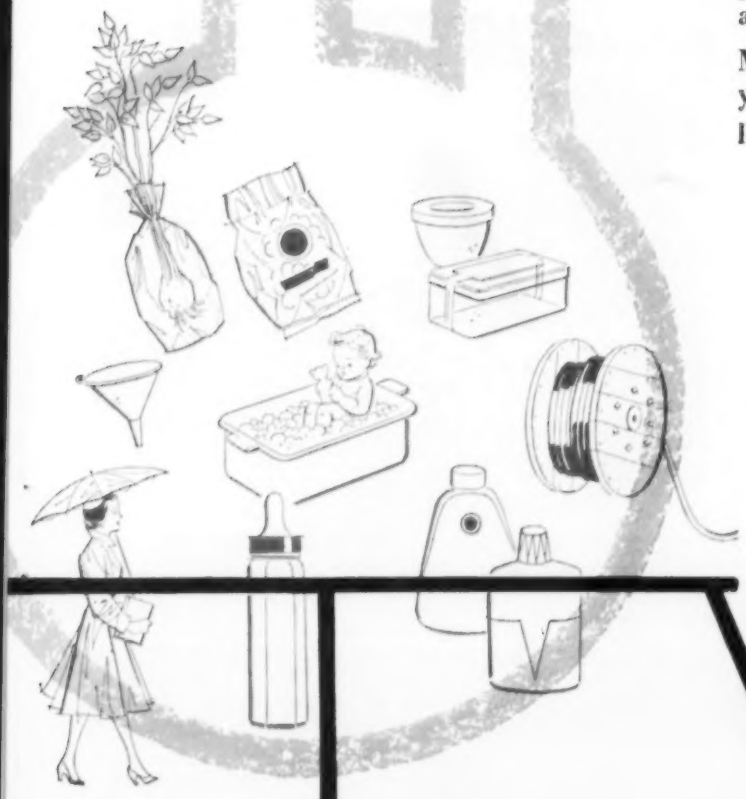
MUEHLSTEIN'S MODULENE*

VIRGIN POLYETHYLENE

. . . available for extrusion and injection molding

Modulene has outstanding low temperature flexibility and toughness, superior chemical inertness, freedom from taste, odor and toxicity, excellent dielectric properties, low specific gravity (.92) and low water vapor permeability.

Modulene's superior properties can offer you production savings and improved products design.



Inquire also about new Super Modulene, the amazing, new High Modulus Polyethylene* that offers greater heat tolerance, toughness, rigidity and chemical resistance.

H. MUEHLSTEIN & CO.

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* *Manufactured by Koppers Company, Inc.*

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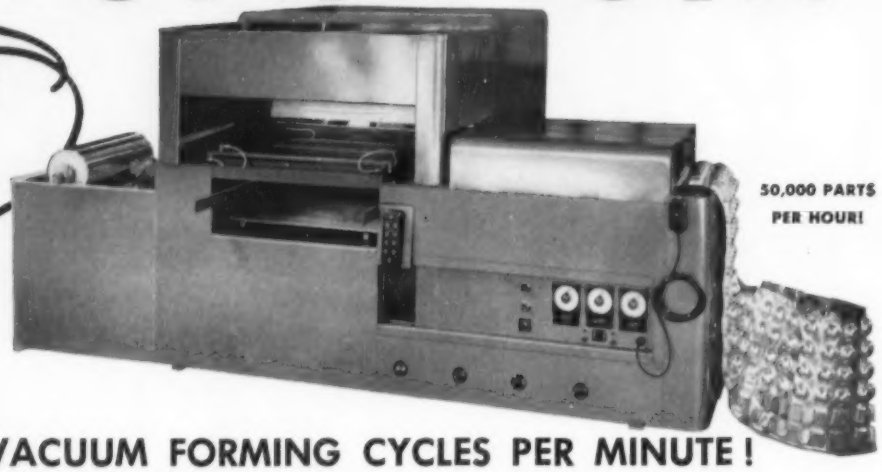
ROLL-VAC 22

COMPLETELY AUTOMATIC ROLL-FEED



50,000 PARTS PER HOUR!

3 FULL VACUUM FORMING CYCLES PER MINUTE!

Introducing the new ROLL-VAC-22, an all purpose drape and vacuum forming machine, capable of 3-4 complete forming cycles per minute. The continuous roll-feed uses standard rolls (up to 22″ wide) of Acetate, Butyrate, Vinyl, Polystyrene, and others. All of these outstanding Auto-Vac developments, proven in the standard machines, are built into the new ROLL-VAC-22 – plus complete automation. No operator is needed once the machine is set up and started. Die-cutting, filling or packaging operation can be synchronized into a continuous production line.

Where more versatility is required—where complex or larger shapes are to be formed—Auto-Vac vacuum forming machines are the obvious choice. They are the most advanced machines available.

Exclusive features include—automatic high-speed cooling for faster cycling • fully adjustable clamping frame, available with adjustable temperature control • lowest consumption uniform Hi-temp Calrod heater unit • heavy duty synchronized toggle action drape mechanism • adjustable drape frame height.

Auto-Vac machines are delivered fully equipped, complete units, ready to go to work. To help you establish and maintain the highest level of production, Auto-Vac will train your personnel at its own plant.

Pioneers!

Pioneers in the development and manufacture of the most advanced vacuum forming machines in the world.

Write today for further information and BULLETIN 55, which gives full information about Auto-Vac's standard drape and vacuum forming machines.

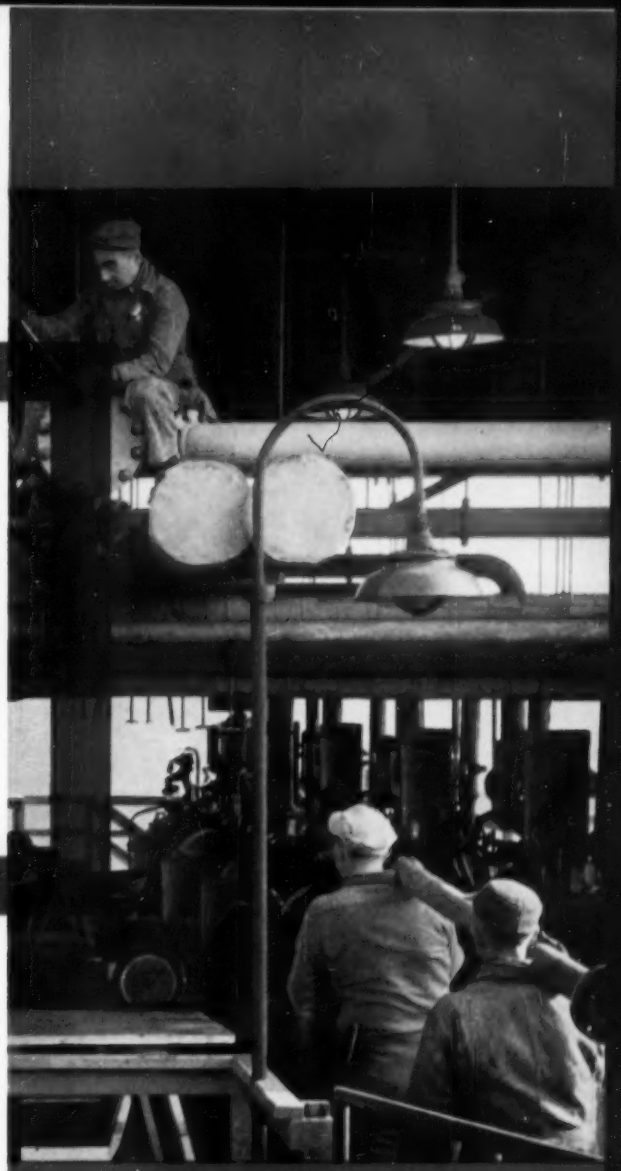
AUTO-VAC Company 1984 STATE STREET EXTENSION • BRIDGEPORT, CONNECTICUT • EDison 4-9481

it won't be long now!

National's Major Plant for large scale production of Aromatic Diisocyanates

NACCONATES*

Nearing Completion at Moundsville, W. Va.



Soon—very soon—polyurethan producers can proceed "full speed ahead"—assured of ample domestic output of NACCONATES (aromatic diisocyanates) for immediate commercial needs.

Our new multi-million dollar NACCONATES plant will multiply available diisocyanate supply many fold. It will help polyurethans to achieve their destiny as "America's next great synthetic".

Pending shakedown of these new facilities, National offers very practical help on polyurethan projects:

- Commercial quantities of NACCONATES from our Buffalo plant for market development work.
- The first comprehensive "product-data package" of six NACCONATES Technical Bulletins, jam-packed with basic technical information on our long line of diisocyanates.
- Field Technical Service on your polyurethan production problems.

We invite you to use these helps to the limit. In view of our desire to handle requests in the order of their urgency, we ask that you fill out the coupon completely and attach it to your letterhead.

NATIONAL ANILINE DIVISION

ALLIED CHEMICAL & DYE CORPORATION

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*Trade Mark

I am ☐ *now working with diisocyanates;* ☐ *working in areas where they may be used;* ☐ *broadly interested in background data.*

☐ *Please send me* NACCONATES *Product Data Package—6 technical bulletins on diisocyanates.*

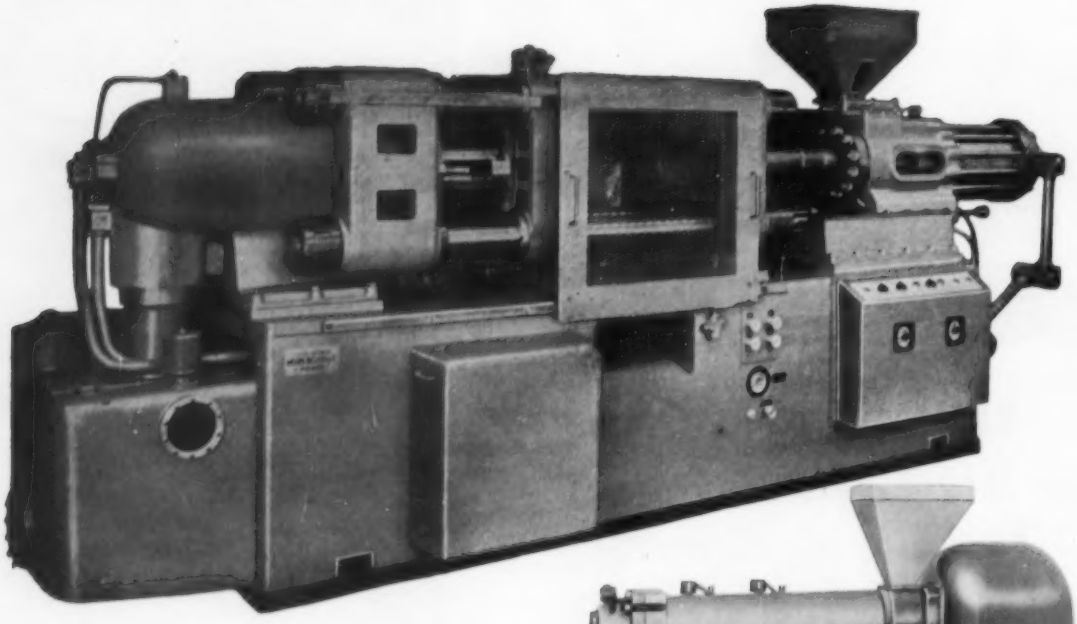
☐ *Have representative call by appointment.*

Name: _____

Position: _____

Company: _____

Address: _____



These machines mean BUSINESS--for you

Inside each of these smoothly-finished housings is an efficient plastics machine, built to deliver long and profitable service. These are just a few in the extensive line of extruders, injection presses and vacuum formers built by Negri Bossi, a great name in plastics processing equipment.

INJECTION PRESSES—Negri Bossi injection presses, like the NB 360/520 shown here, can be set up almost anywhere because they get their operating pressures from a built-in oil-hydraulic drive that needs only electricity to operate. The new-design electrical system makes service and operation simplicity itself. Service of the cylinder, screw, nozzle and heaters is also simple; they can be removed as a unit by just one person. The operator is protected by an automatic device that prevents operation when the safety gate is open. Automation is a built-in feature of Negri Bossi presses; simply by shifting a lever, the operator can choose semi-automatic or fully-automatic cycling.

EXTRUDERS—Negri Bossi single screw extruders are available in models with 30mm, 45mm, and 60mm screw diameters (Types T/30, T/45 and T/60). Screws are made in a wide variety of designs out of a special chrome-hardened steel. Among the types of die heads available are those for making tubing and profiles, for coating wire and for blowing tubular sheeting. Ball bearings are used throughout the extruders at all points of friction. A built-in cooling system circulates water through the entire machine.

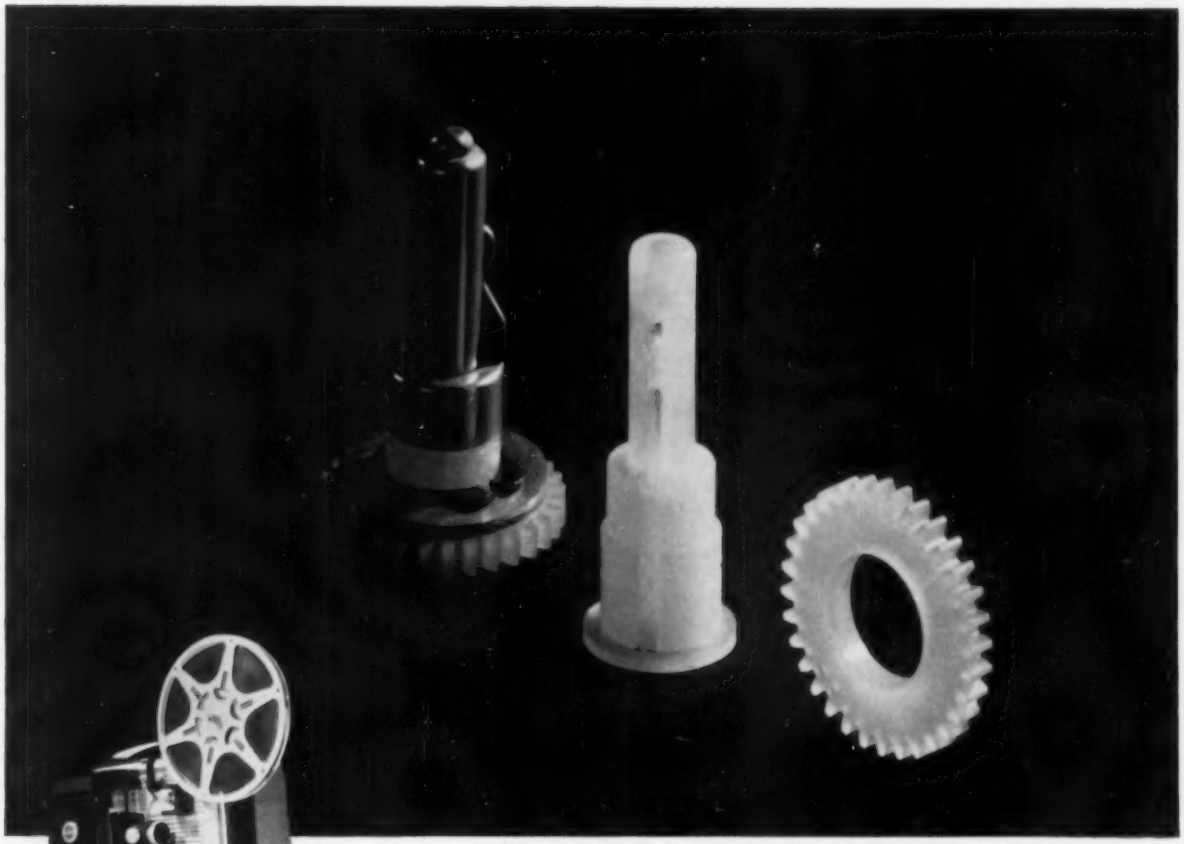
Negri Bossi also makes a full line of extruder take-off equipment.

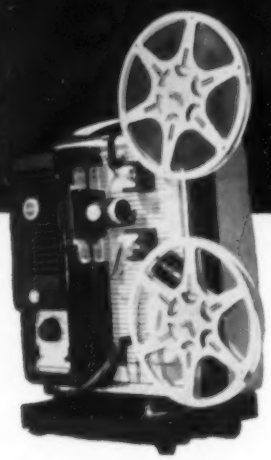
VACUUM FORMERS—Here is something *really* sensational! Negri Bossi introduces vacuum formers with patented movable, variable infra-red heaters that concentrate heat where it is most needed, assuring constant cross-sections throughout formed pieces and permitting extremely deep draws. Negri Bossi also manufactures a low-cost model for laboratory and test-run use, and a high-output machine with two 25⅝" by 35⅝" stations.

Write for detailed information on machinery made by Negri Bossi, one of the world's largest manufacturers of plastics processing equipment.

NB&C **NEGRI BOSSI & CO,** Milano *(Italy)*

Corso Magenta, 44 — **Cable address: "Gianimar"**





Here are 2 of more than 30 Quinn-Berry parts used in Eastman Cine-Kodak Showtime 8 Projector.

AT QUINN-BERRY THE UNUSUAL IS ROUTINE

In one unusual application, the molded nylon gear and spindle shown above—along with seven sheet metal and two steel parts—form the reel-spindle assembly. Using two of these assemblies on each projector to mount the film reels, Kodak has effected a considerable saving compared to the cost of conventional machining methods.

Quinn-Berry molded nylon parts provide a high degree of uniformity . . . have long-wearing characteristics . . . require little or no lubrication. For example, the gear in the reel-spindle assembly, although subject to friction when the projector is in operation, requires no lubrication.

At Quinn-Berry, every job is engineered, step by step, from die design to finished product under one responsibility and one control . . . the reason why "The Unusual is Routine at Quinn-Berry".

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HOLDERS OF ALL TYPES OF THERMOPLASTICS

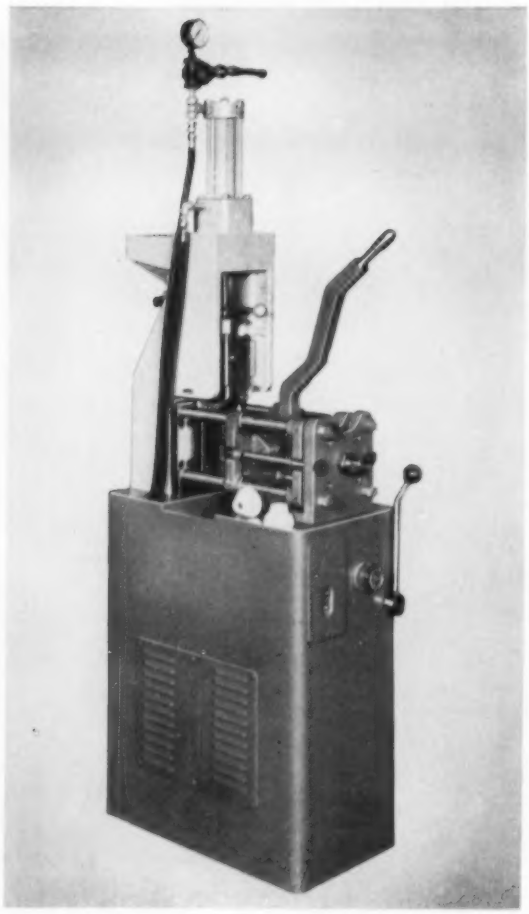
big profits
on small jobs
with the

MINI-JECTOR

TRADE MARK

the proven, low-cost, economical plastic injection molding machine

Here are the small thermoplastic injection molding machines that do a small job in a big way! Economical to operate and low in cost, these ¾ ounce plastic injection molding machines are turning out thousands of small plastic items every day for hundreds of satisfied users. Molds any thermoplastic . . . including Nylon. The Mini-Jectors are the most versatile machines in their class. Simple and compact in design, Mini-Jectors operate easily and efficiently and owners everywhere find they pay for themselves many times over.



MODEL 60 "HORNET" ¾ oz. injection capacity. Mold size 6" x 5" x 5⅛". Will plasticize 5½ lbs. per hour. Hydraulic injection system, also available for air operation . . . semi-automatic knockout speeds operation and mold change.

MODEL 43 "WASP" ¾ oz. capacity air-operated Mini-Jector . . . fast and economical. 6" air cylinder operates ram . . . 40 to 150 pounds of air pressure required depending on type of plastic used and product being molded. Material hopper capacity 4 pounds.

Mini-Jectors are small production machines. They offer the most economical way of injection-molding small plastic articles (¾ oz. or less) where there is no need for high-speed production.

In addition, Mini-Jectors are ideal equipment for developing new plastic products. You can make up a few dozen, several hundred, or thousands in the exact color and design to test market reaction before you tool up for full production. In many cases, the Mini-Jector will take care of the entire production requirements.

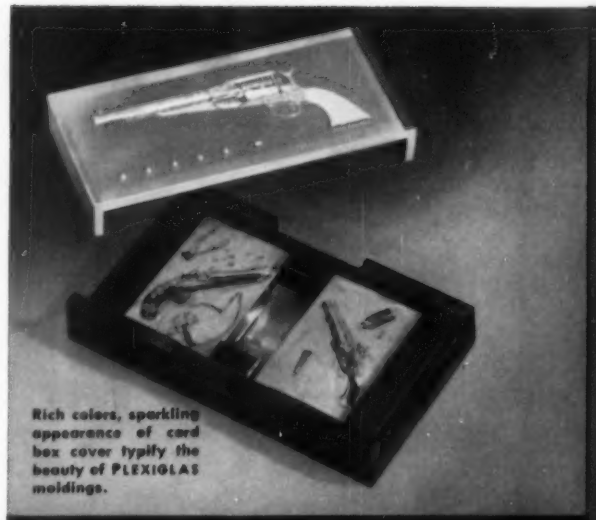
Any Thermoplastic including NYLON may be molded with a Mini-Jector.

EVERY DAY THOUSANDS OF ITEMS ARE BEING PRODUCED PROFITABLY ON THE MINI-JECTOR.

WRITE TODAY for free literature that will tell you how you can use the Mini-Jector to solve your injection molding problems.

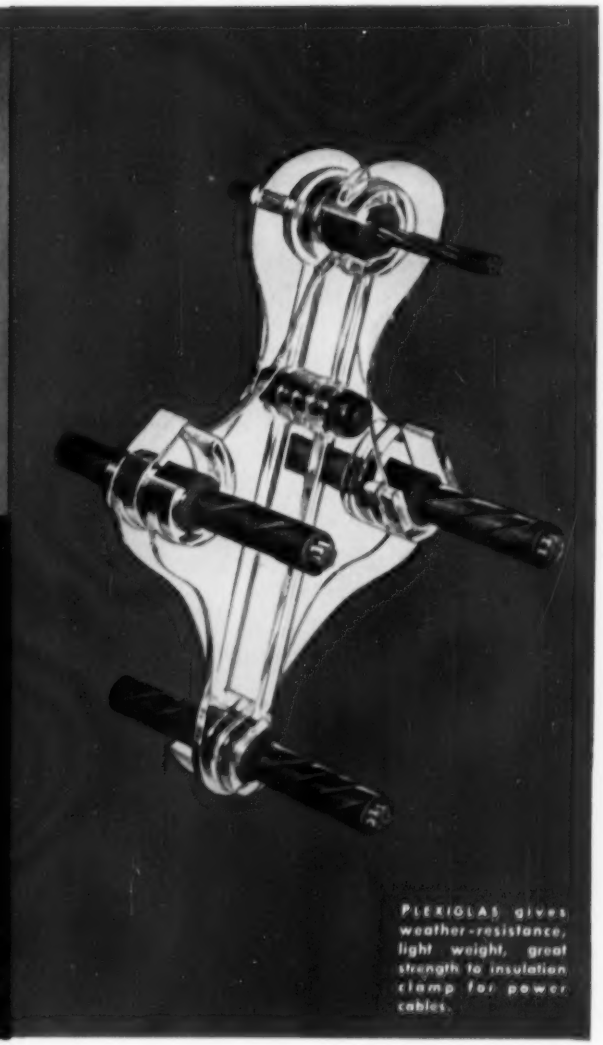
NEWBURY INDUSTRIES 202 Munn Road, Newbury, Ohio

Specializing in the Production and Development of Plastic Injection Molding Machines of One Ounce or less Capacity.



Rich colors, sparkling appearance of card box cover typify the beauty of PLEXIGLAS moldings.

Water meter cover molded of PLEXIGLAS has excellent clarity, high resistance to impact.



PLEXIGLAS gives weather-resistance, light weight, great strength to insulation clamp for power cables.

Designed with **PLEXIGLAS** *in mind*

Products like those shown above have proved successful because their designers and molders took advantage of the properties of PLEXIGLAS® acrylic plastic. Whether *your* requirements for a molded part are rugged durability or gleaming beauty, or both, PLEXIGLAS can provide the answer.

Here are the reasons why so many types of products in varied fields of industry today are planned to be molded of PLEXIGLAS—the resistance of this acrylic plastic to weather, heat and breakage . . . its crystal clarity, resulting in depth and brilliance of colors when back-surface paints and metallized coatings are applied . . . the optical effects possible . . . its ability to be molded accurately into complex shapes.

Our technical representatives and Design Laboratory staff would like to show you how PLEXIGLAS can solve specific problems involving molded plastic parts.

Chemicals for Industry

ROHM & HAAS COMPANY

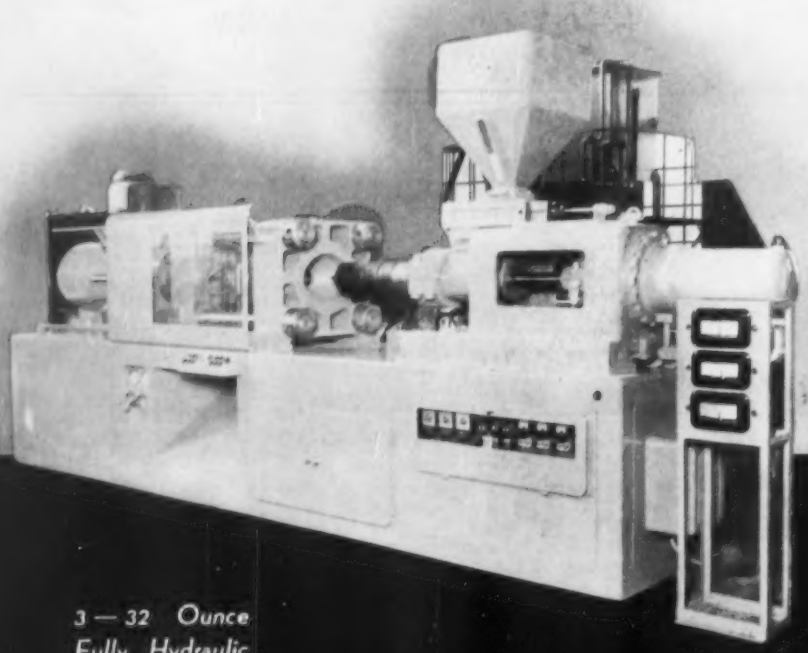
WASHINGTON SQUARE, PHILADELPHIA 5, PA.

Representatives in principal foreign countries

Canadian Distributor: *Crystal Glass & Plastics, Ltd., 130 Queen's Quay at Jarvis Street, Toronto, Ontario, Canada.*

"MEIKI" INJECTION M.M.

- ★ Specially designed long cylinder assures quick and uniform melting; the cylinder can be easily replaced.
- ★ Hydraulic clamping system eliminates troublesome staynut adjustment.
- ★ U.S. Standards are adopted on machine parts, European are also available if requested.
- ★ Either Meiki hydraulic system or Oilgers can be fitted at your option.



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is in

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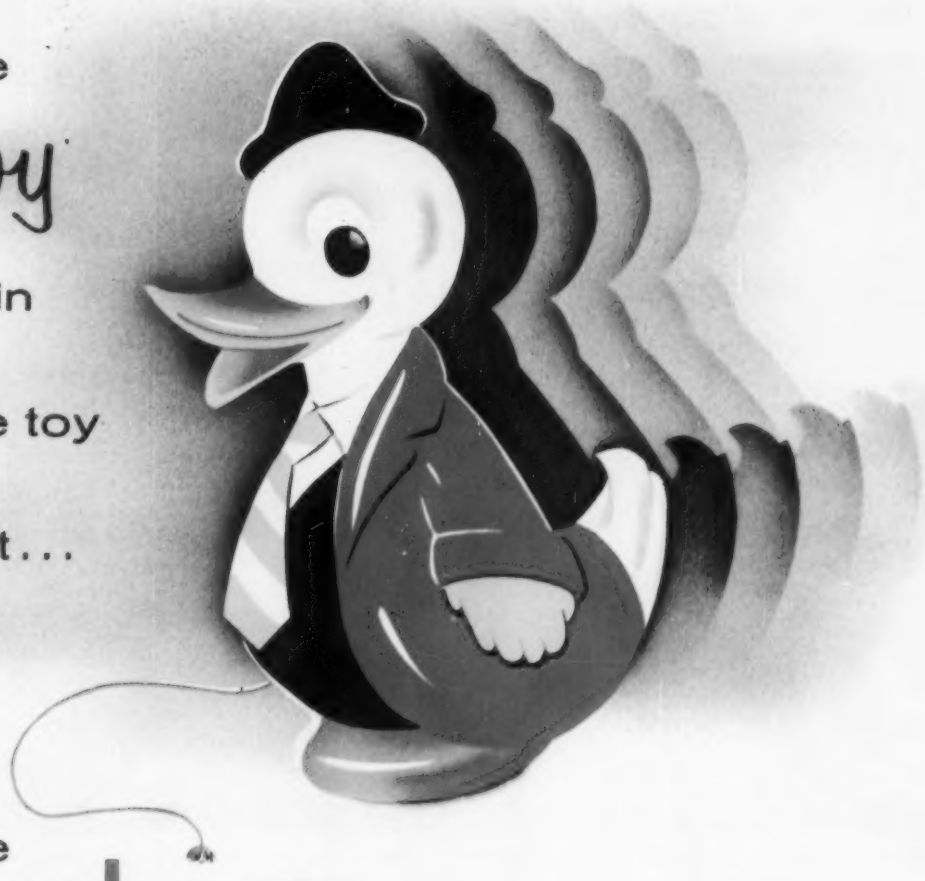

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color makes the **SALE!**

It's a known fact . . . the quickest way to Pop's pocket is through the eyes of a child.

It's a known fact . . . an infant first distinguishes objects by their COLOR.

It's also a known fact that, in the final analysis, it's the consumer you have to sell. Whether you make toys or any other plastic product for consumer use, your brand will outsell all others . . . if it has the **basic** appeal of COLOR.

At Westchester Plastics, we are ready to custom-create for your product the color with the maximum SALES COMMAND. Or you can select from our wide range of standard colors. For color know-how and quality color at quantity prices, the industry looks to Westchester.

Write today for information on how you can use COLOR to sky-rocket your profits.

WESTCHESTER PLASTICS, Inc.

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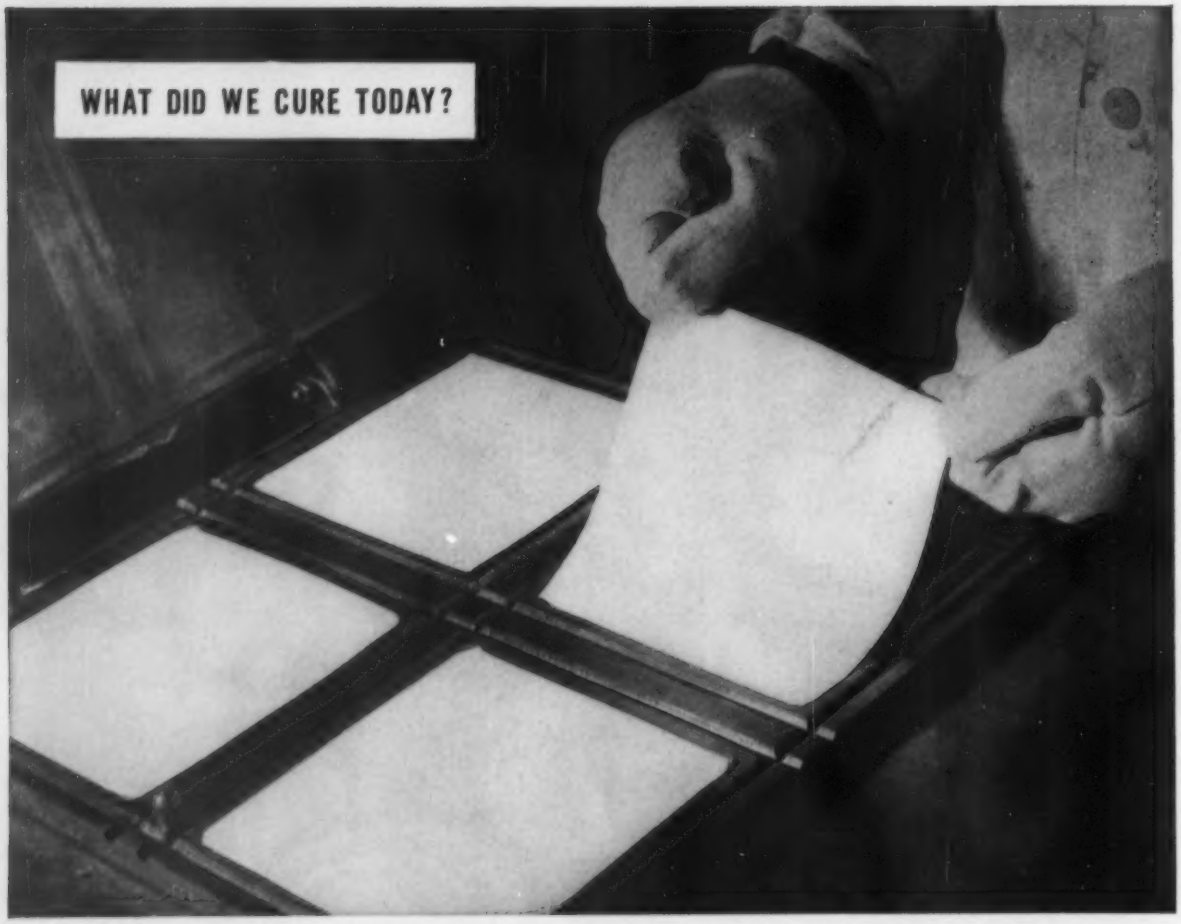
Custom Compounders of Thermoplastic Materials

Manufacturers and Developers of Unicolor & Formacolor



Natural Rubber . . . GR-S . . . Buna N . . . Silicones . . . Polyethylene? The above could be any of them or one of many other polymers, when versatile Di-cup is used as the curing agent.

DI-CUP* A NEW "CURE-ALL" FOR POLYMERS?

Coming off a curing press, this slab could be any of a number of materials that can be economically and efficiently cured with new Hercules Di-cup (dicumyl peroxide).

The first new widely applicable method of curing without sulfur or a sulfur-containing compound to be developed in 117 years, Di-cup produces carbon-to-carbon cross linking that makes it practically a "cure-all" for polymers.

Di-cup is a stable peroxide of low volatility. Economical to use, Di-cup vulcanizates exhibit good aging, good low temperature performance, and low compression set. White stock is not discolored and good color retention is obtained. Silicones cured with Di-cup are free of gas bubbles and acidic by-products.

Why not learn more about this new curing agent? Write to Hercules for additional data and information on available commercial forms.

Naval Stores Department

HERCULES POWDER COMPANY

INCORPORATED

916 Market St., Wilmington 99, Delaware

*Hercules trademark

NOSS-1

FROM

Design

TO

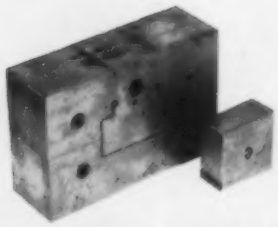
Delivery

LOOK TO WATERTOWN

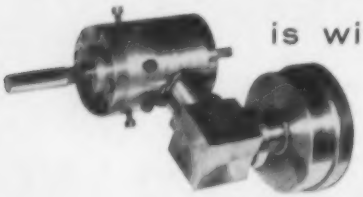
Plastics is *our* business . . . so why should *you* grapple with the problems of choosing the *right* material . . . the correct method . . . the best design? That's what we're here for . . . to give you the benefit of our 41 years' experience in conceiving, developing and executing hundreds of plastics engineering jobs. Our designers, engineers, chemists and production specialists are at your service. From the *right* plastics material—and we work practically all thermosetting and thermoplastic materials . . . by the right process—compression, injection, transfer molding, or vacuum forming . . . we stand ready to produce a product to your most exacting requirements. It will pay you to consult Watertown—*first!* Simply write to . . .

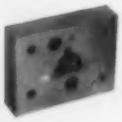
THE WATERTOWN MANUFACTURING CO.

1000 ECHO LAKE ROAD, WATERTOWN, CONNECTICUT

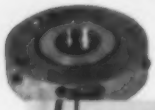


THE RIGHT BEGINNING for any extrusion, large or small is with a ROBBINS DIE





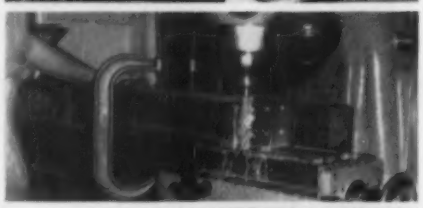
. . . and we're ready to prove that it pays to buy extrusion dies from a specialist. Write for an estimate—dozens of companies (domestic and foreign) have switched to Robbins. No obligation, of course. You can phone us at 2-4060 Elkhart, Indiana.



Our engineers have designed hundreds of extrusion dies. They're specialists. That's why a Robbins die generally costs less . . . and invariably have a greater yield!

DESIGN

Single orifice to complicated sheeting or pipe dies, Robbins tools every job to perfection. Die makers with years of experience and the newest in machine tools build the dies that answer your extrusion problems.



MANUFACTURE

Final polish, assembly and inspection are specialist operations, too. Here, again, specialization pays off in quality and performance of every Robbins built die.

HAND FINISHING

When a Robbins die is delivered, you know it's right. Because we test it—prove it—by submitting samples from a test run in our own plant. In addition, our engineers are available to help you set up your job.

TESTING

Robbins

never say die . . . say Robbins die

PLASTIC MACHINERY CORP.

1430 MISHAWAKA STREET • • • ELKHART, INDIANA

at the 7th National Plastics Show!

Vinyl tells an exciting story about the future of your product at the Firestone Exon Booth No. 813-815.

In this exhibit of Exon, industry's most complete source of vinyl resins, you will discover how many new ways vinyl will enrich your product —and your profit picture.

Of very special note is a new and highly promising use of that remarkable plastisol resin, Exon 654. The new development, VINYLFOAM, has been proved outstanding in cushioning, safety, utility and economy.

This is new and dramatic evidence of the plastics industry's limitless opportunities, particularly in vinyl.

We expect Exon 654, with all its exceptional properties, to play a major role in its advancement . . . as all Exon resins are contributing to the growing significance of plastic in industrial and consumer life.

We invite you to be our guest.

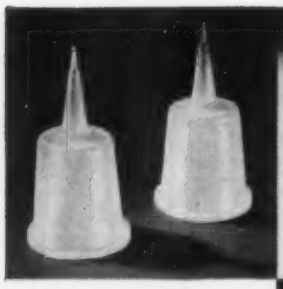
SPI 7th National Plastics Exposition New York Coliseum June 9-13 1958

Firestone

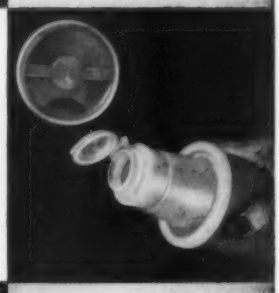
EXON

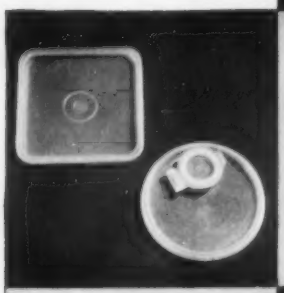
.... CHEMICAL SALES DIVISION

FIRESTONE PLASTICS COMPANY, POTTSTOWN, PA.
DIVISION OF THE FIRESTONE TIRE & RUBBER CO.



NOBODY HAS AS MUCH EXPERIENCE AT MOLDING POLYETHYLENE AS TUPPER!





Tupper Seals are air and liquid-tight flexible covers. The famous Pour All and Per Top covers are designed for easy dispensing. They are made in sizes to fit all Tupperware containers.

The logical molder for you to consult regarding that product or package of yours which is to be made of polyethylene is Tupper. Tupper has done more than any other molder to make molded polyethylene a practical reality.

Aside from having designed, patented, and promoted successful seals, closures, and dispensers for polyethylene containers, the Tupper Corporation has vast experience in *every phase* of polyethylene packaging and polyethylene injection molding. This experience will be of major importance in improving your product, in reducing your costs, when Tupper goes to work for you.

Tupper's combination of experience, technical ingenuity, and the most modern equipment is at your service for the custom molding of your product in polyethylene. You can do no better than the best ...and the best at molding polyethylene is Tupper!

When equipped with Tupper Seals, Tupper Canisters, Sauce Dishes, Wonder Bowls, Cereal Bowls and Funnels in various sizes are the most versatile reusable containers you have ever seen.

TUPPER!
TRADE MARK

TUPPER PRODUCTS ARE FULLY PROTECTED

About 150 United States and foreign patents and patents applied for, plus numerous trademarks and copyrights, cover the design and manufacture of the various types of Tupper Seals and other Tupper Products. Unauthorized manufacture of items covered by Tupper patents will subject infringers to prosecution.

TUPPER CORPORATION

Manufacturers of — CONSUMER, INDUSTRIAL, PACKAGING AND SCIENTIFIC PRODUCTS

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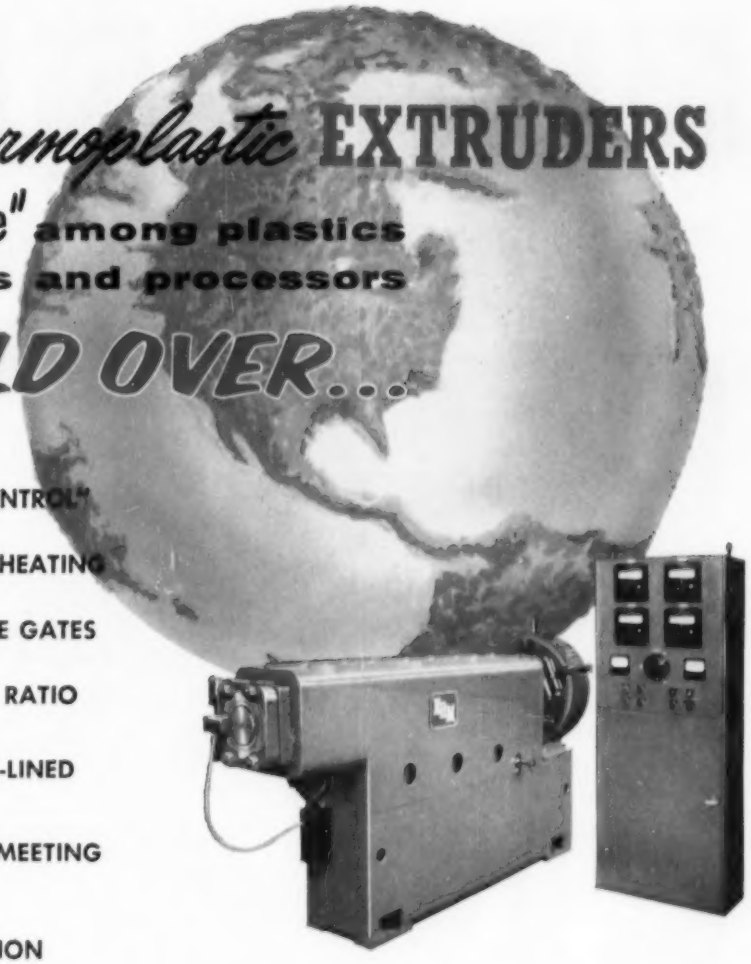
Address All Communications To: Dept. M-5

10 reasons why NRM *thermoplastic* EXTRUDERS are "first choice" among plastics manufacturers and processors THE WORLD OVER...



1. "BALANCED HEAT CONTROL"
2. "CAST-IN" CYLINDER HEATING
3. "QUICK-OPENING" DIE GATES
4. ONE-PIECE 20:1 Le/D RATIO CYLINDERS
5. SINGLE WALL XALOY-LINED CYLINDERS
6. CONTROL CABINETS MEETING J.I.C. CODES*
7. RUGGED CONSTRUCTION THROUGHOUT
8. A COMPLETE LINE OF EXTRUDERS (UP TO 12")
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10. FEED SCREWS FOR EVERY EXTRUSION NEED

*Joint Industrial Council

Make NRM Thermoplastic Extruders and accessory Equipment your first choice, too, and *profit* by these 10, and many other design and operating advantages. Learn more about the NRM full line by writing for more details today. Our plastics engineers will be happy to discuss your extrusion requirements and recommend the right type and size NRM Extruders and Accessories to do your work most efficiently. There's no obligation.

2587

NATIONAL RUBBER MACHINERY COMPANY

NRM

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"Poly-Eth" News from the Southwest

Sam Silberkraus
Los Angeles

Dick Bishop
Chicago

Pete Dornik
Chicago

Vic Denslow
Chicago

Carl Virgin
Ohio

Reported by
JOHN COWDEN
Spencer "Poly-Eth"* Sales Representative, Dallas, Texas

The polyethylene industry is fast becoming big business in the great Southwest Among the reasons: the proximity of polyethylene producers and ideal weather conditions.

Good service and good resins, of course, also speed the development of the Southwest's polyethylene industry And Spencer Service and Spencer "Poly-Eth" resins are playing a big part in this.

In the paper coating field, for example, "Poly-Eth" 2007 has been doing an outstanding job. A large paper coating company in Louisiana is only one of a number of companies reporting excellent results with 2007.

"Poly-Eth" is going great guns in the injection molding field, too. An Oklahoma molder is using "Poly-Eth" to make advertising holders to be fastened on grocery carts. A Texas molder is getting wide acceptance for polyethylene vacuum bottles in both pint and quart sizes.

Polyethylene pipe extruders are reporting a big increase in business for 1956. Much of this increased demand has come from the continued growth of polyethylene pipe for irrigation purposes.

P.S.--To get better acquainted with "Poly-Eth," be sure to stop by the Spencer exhibit at the National Plastics Exposition.

*A registered trademark of Spencer Chemical Co.

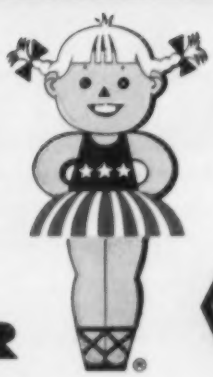
SPENCER CHEMICAL COMPANY

GENERAL OFFICES: Dwight Building, Kansas City 5, Missouri

DISTRICT OFFICES: Dwight Building, Kansas City, Missouri, BAltimore 1-6600; 500 Fifth Avenue, New York, New York, LAckawana 4-7762; First National Bank Building, Chicago, Illinois, ANdover 3-2656

WEST COAST SALES AGENT: Riverdale Plastics and Chemical Company, 8510 Warner Drive, Culver City, California, TExas 0-1000

WAREHOUSES: New York City, Chicago; Los Angeles; Orange, Texas



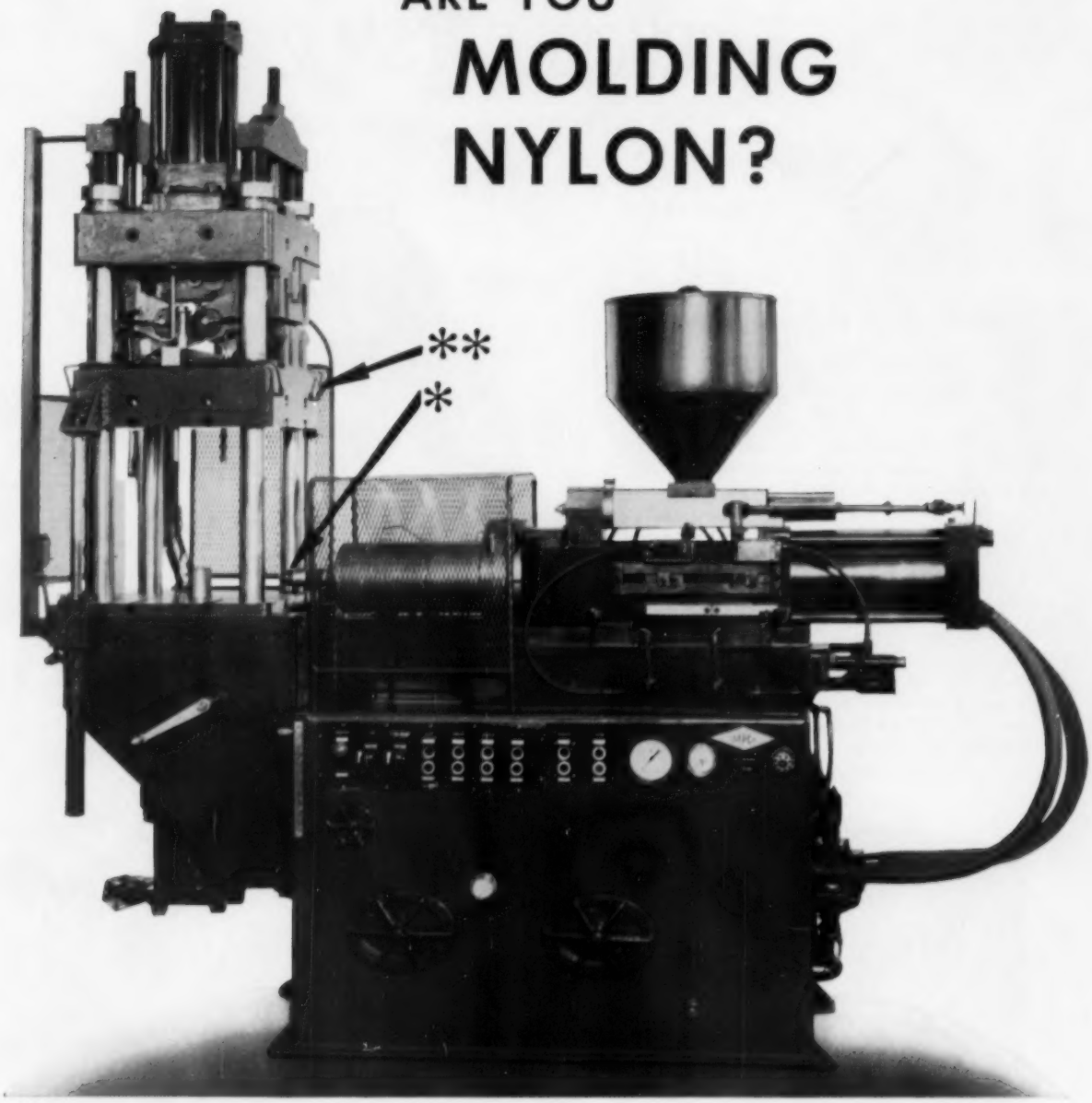
NPE
Booth 237
NEW YORK

"Poly-Eth" invites you to visit the Spencer exhibit at the National Plastics Exposition, June 11-15.

SPENCER

Poly-Eth *by* **SPENCER**

ARE YOU MOLDING NYLON?



IMPCO VA4-175-19 — 4-6 OUNCES

SPECIFICATIONS

Injection Capacity	4-6 oz.
Injection Pressure (Plunger)	21,750 p.s.i.
Plasticizing Capacity (Polystyrene)	75 lbs./hr.
Clamp Pressure (Toggle)	175 tons
Clamp Stroke	8"
Die Thickness	Max-14" Min-8"
Machine Cycle (Dry Run)	7/Min.
Auxiliary Bottom Ram	19 Tons
Dimensions	Length-102", Height-112", Width-60"
Weight	Approx.-9000 lbs.

*No drool problem with this easily controlled check valve type nozzle.

**Vertical type press-ideal for insert molding.

If you are a nylon molder, you must investigate this Impco machine!

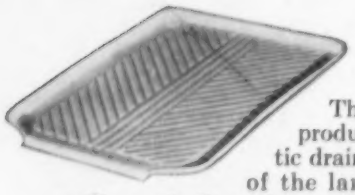
IMPCO®

IMPROVED MACHINERY INC.
NASHUA, NEW HAMPSHIRE

even for the big ones it's

CRUCIBLE CSM 2

. . . from warehouse stock



The mold which produced this plastic drainboard is one of the largest plastic molds ever built on the west coast. A block of CSM 2 was the steel used . . . obtained from local *Crucible warehouse stock*. L. D. Plastic Tool and Die Co., South Gate, California, built the mold for Alladin Plastics, Inc., Los Angeles.

CRUCIBLE CSM 2 was the choice for two big reasons—*quality* and *convenience*. Ultrasonic inspection of *every* piece, regardless of size, insures unvarying quality. And regular stocks of 205 different sizes of CSM 2, carried in Crucible warehouses, means *fast* delivery whether your application calls for a pound or several tons.

Next time you need mold steel, call your nearest Crucible warehouse. The steel you want will be in your plant in a matter of hours. *Crucible Steel Company of America, The Oliver Building, Mellon Square, Pittsburgh 22, Pa.*

CRUCIBLE first name in special purpose steels

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HEAT V LIGHT

HARSHAW VINYL STABILIZERS

for the vinyl plastic and coating industries

Important additives for processing and stabilizing clear and opaque vinyls—

CALENDERED FILMS AND SHEETS • EXTRUSIONS
RIGIDS AND FLEXIBLE
PLASTISOLS • ORGANOSOLS • COATINGS

CADMIUM 2-V-4

Leading heat and light stabilizer for clear or opaque stock, an organic liquid complex containing no disadvantageous soapy component. Unequalled for stabilizing against effects of sunlight or outdoor aging.

BARIUM-CADMIUM 128-V-5

Leading combination of coprecipitated laurates for outstanding performance, where lubricating advantages are required. Generally 30% more effective than common barium-cadmium laurates.

Write for a Vinyl Stabilizer Check List that you may use to detail as much as possible your particular requirements.

A practical stabilizing system will be suggested promptly, based on our experience with the various Vinyl Polymers and Copolymers and with the different Plasticizers, for your processing and product end-use requirements.

THE HARSHAW CHEMICAL CO.
CLEVELAND 6, OHIO

Best effects are attained for particular requirements by combining 2-V-4 or 128-V-5 in a stabilizing system with one or more of the following three stabilizers.

BARIUM 1-V-4

Compatible barium compound, minimum effect on viscosity. Permits processing at higher temperatures.

ORGANIC 8-V-1

Chelating agent, more than two times as effective as common organic phosphites. Inactivates harmful by-products to boost stability. Contributes to top clarity.

ORGANIC 7-V-2

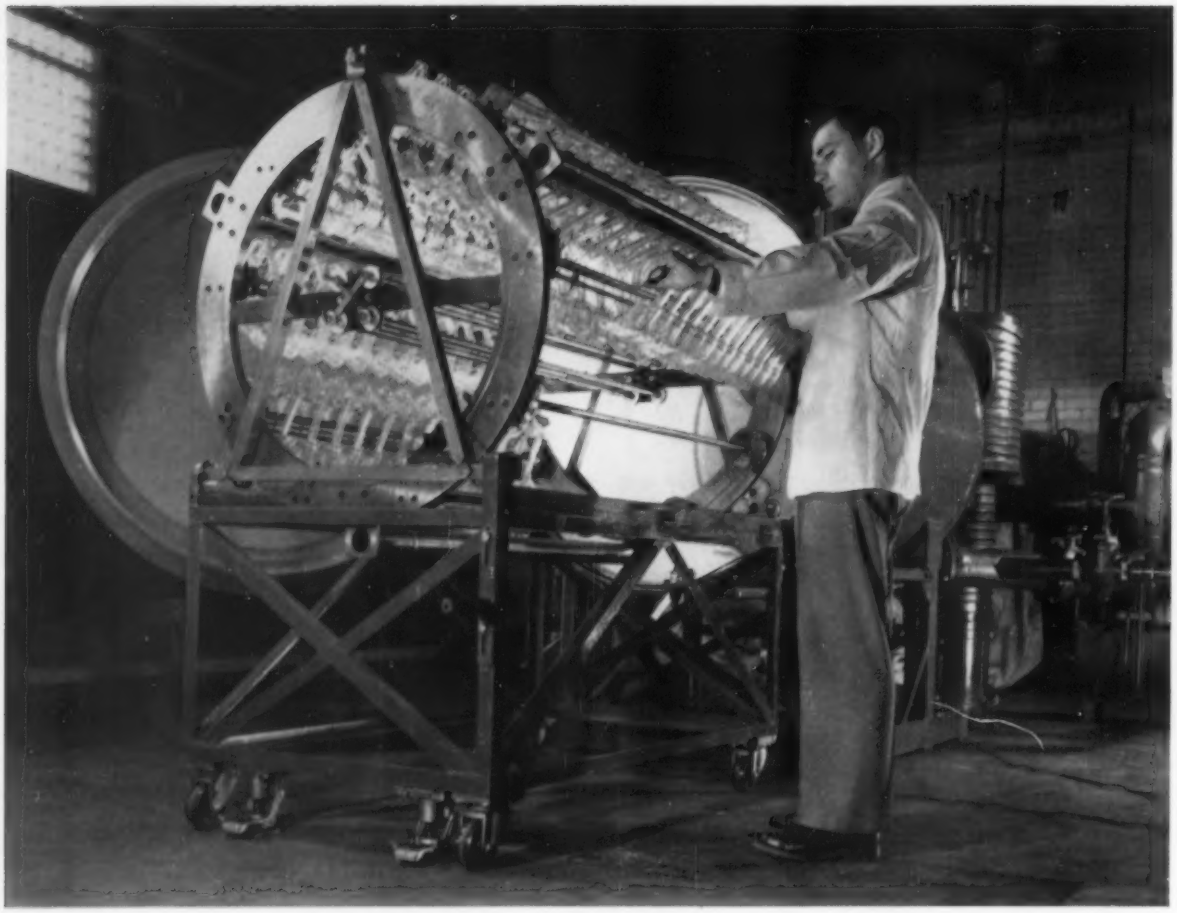
Epoxy assistant, highly effective HCl scrubbing agent, undiluted. Will extend stability for longer processing periods.

CADMIUM 28-V-2

For rigids, opaque to translucent. Stabilizes unplasticized resin efficiently and economically, with minimum effect on physical properties of product.

Stabilizing Systems developed for Harshaw Customers, for special processing and finished product properties, may contain one of the following stabilizers.

ZINC 9-V-1: Organic liquid complex containing no disadvantageous soapy component used in selected formulations.
CADMIUM 2-V-7: For modified solutions and organosols.
CADMIUM 24-V-1: Organic liquid complex for highest attainable clarity, used principally with dispersion resins.
CADMIUM 2-V-400: Modified 2-V-4.
CADMIUM 2-V-8: Selected laurate, used principally with low fusing resins.
BA-CD 12-V-5: Coprecipitated laurate.
CADMIUM 22-V-1: For rigid, clear and opaque stocks.
ORGANIC 7-V-1: Epoxy assistant.
ORGANIC 7-V-4: Epoxy assistant, for rigids.
BARIUM 1-V-3: Dispersible stearate, to contribute lubricity with barium effects.
BARIUM 1-V-6: For asbestos filled tile.
BARIUM 1-V-7: Liquid, for modified plastisols and organosols.
CALCIUM 5-V-1: Dispersible stearate, to contribute with calcium effects.
CALCIUM 5-V-22: Dispersible, low melting stearate to reduce internal friction.
ORGANIC 8-V-100: Modified 8-V-1.



How to get new business with a new process . . . *vacuum metallizing*

Add vacuum metallizing to the services you render to customers, and you'll brighten your products *and* your profits at the same time.

Perhaps you'll even have the key to the doors of new customers.

Vacuum metallizing is an economical way to give color and high-quality finish to plastics, metals, glass and other materials.

Using lacquers and various metals (low-cost aluminum is one of the best), you can offer an almost infinite number of rich-looking colors and finishes—all beautifully highlighted by a mirror-like backing.

Vacuum metallizing is an easy operation. Average personnel can become expert coaters in a few hours.

There are a variety of *CVC* machines to fit your budget and needs:

For mass production—For coating large pieces and mass coating medium- and small-sized pieces, we recommend the 48″ coater shown above. With this coater you can metallize from hundreds to thousands of pieces per cycle—depending upon the type and size of material being coated. You can run 3 to 6 complete process cycles per hour.

For medium quantities—The 30″ coater is more economical for medium quantity runs. The specific amount that can be metallized per cycle again depends upon type and size of material. You can easily attain 5 to 7 cycles per hour.

For optics, lab and pilot plant—Small coaters are available for production coating of optics and other small parts, and for laboratory and pilot plant work.

Literature and help—Before you decide on any coater, send for technical data on the complete *CVC* line. One of our sales engineers will be glad to help you decide which type and size best meets your needs.

CVC

Consolidated Vacuum, Rochester 3, N. Y.

a division of **CONSOLIDATED ELECTRODYNAMICS CORPORATION**, *Pasadena, California*

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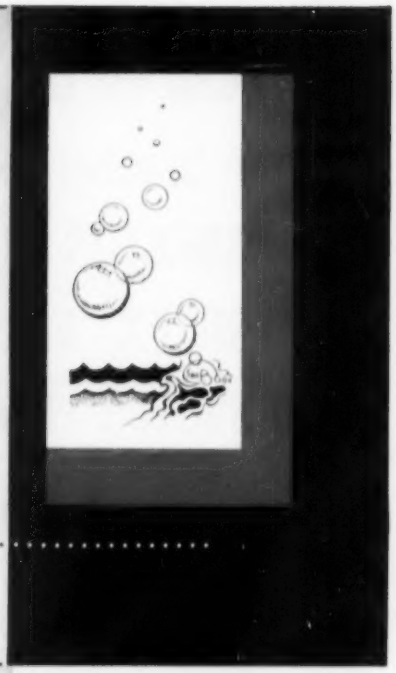
another important advantage

to manufacturers of vinyl products

DRAPEX 3.2

LOW TEMPERATURE EPOXY PLASTICIZER

provides LOW SOAPY WATER EXTRACTION



The chart on the right shows the results of tests conducted to compare the soapy water extraction of Drapex 3.2 with other plasticizers. Equal size samples of the various materials were laundered in a small washing machine for ½ hour in a ½% Ivory Soap solution, at a water temperature of 150° F. The samples were spun dry, rinsed in fresh water for 10 minutes at 150° F. They were then dried in an air circulating oven at 212° F. Assuming that all losses are plasticizer losses, the chart reveals the important advantage of Drapex 3.2.

In addition, the low temperature flexibility of Drapex 3.2 is superior to DOA. Its lower specific gravity is combined with a low volatility.

The epoxy content of Drapex 3.2 provides excellent stability, high heat resistance, and good weathering characteristics. All of these advantages help you make better, longer lasting vinyls at lowest cost. Make your own test and see. Write today for Technical Bulletin 4 and a generous working sample.

SOAPY WATER EXTRACTIONS (½% Ivory Soap Solution @ 150° F.)

COMPOUNDS TESTED — Resin	100.0	100.0	100.0	100.0	100.0
Dioctyl Phthalate	45.0	30.0	30.0	30.0	30.0
Dioctyl Sebacate	—	15.0	—	—	—
Dioctyl Adipate	—	—	15.0	—	—
Butyl Epoxy Stearate	—	—	—	15.0	—
▶ DRAPEX 3.2	—	—	—	—	15.0
Per Cent of Total Plasticizer Lost — 5 Laundering Cycles	3.9%	2.3%	6.9%	12.7%	2.6%
6 Laundering Cycles	4.9%	3.1%	8.7%	14.6%	3.5%
7 Laundering Cycles	6.0%	4.2%	10.3%	16.5%	4.4%
8 Laundering Cycles	6.6%	4.7%	11.4%	17.9%	5.1%
9 Laundering Cycles	8.5%	5.7%	13.8%	19.8%	6.1%
10 Laundering Cycles	9.3%	6.5%	14.7%	20.4%	**6.8%**

"PURR-FECTION"

ARGUS CHEMICAL CORPORATION

633 COURT STREET BROOKLYN 31, N. Y.

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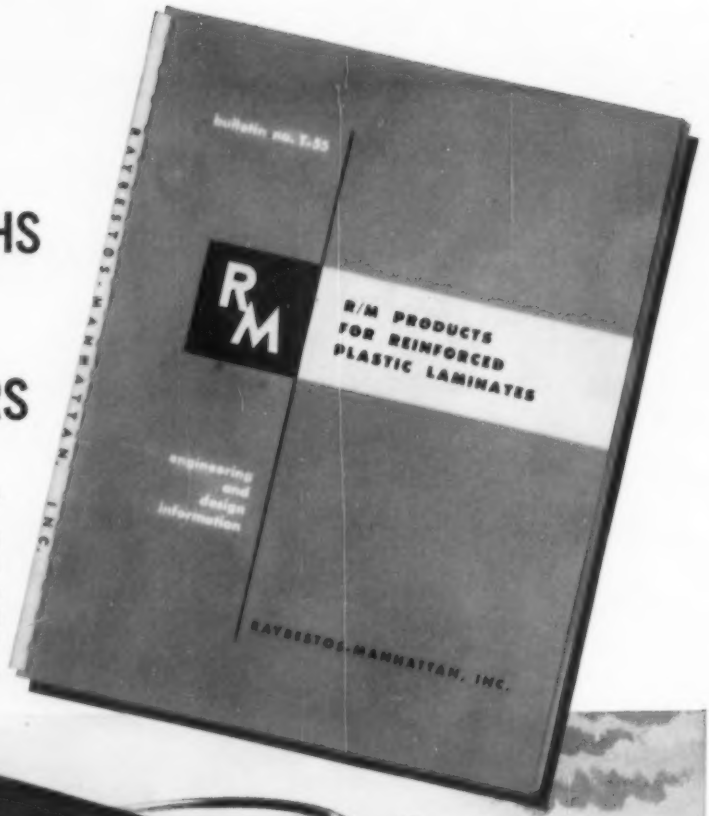
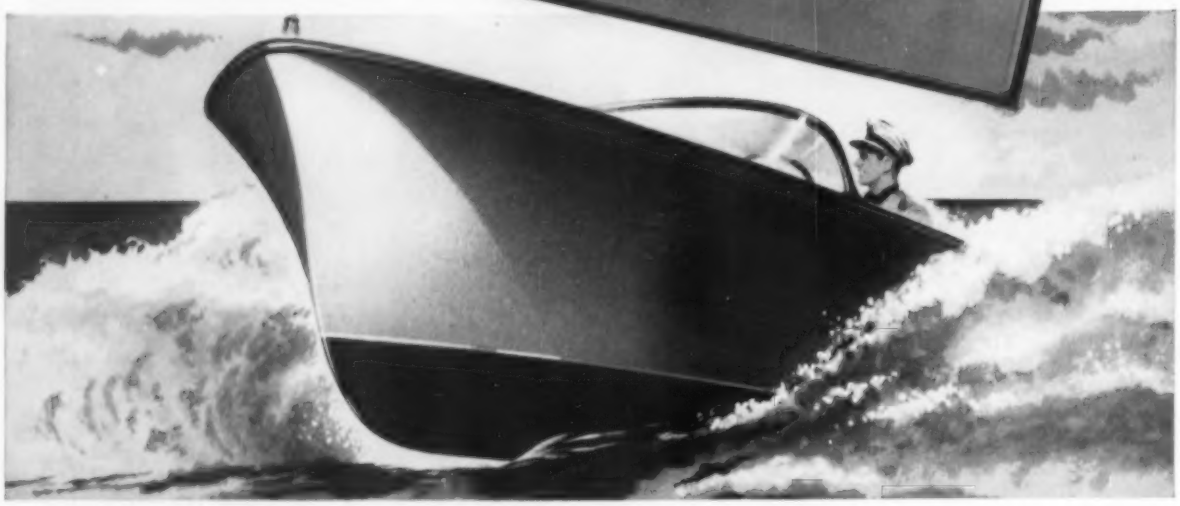
Send for this free brochure on R/M ASBESTOS CLOTHS PYROTEX® FELTS NOVABESTOS® PAPERS



CONTAINS TECHNICAL AND DESIGN DATA

R/M Bulletin No. T-55 and supplemental Technical Data Sheets present useful fundamental information for high and low pressure laminators. This material should suggest new uses and markets to you for scientifically engineered plastic products.



EXAMPLE

It describes R/M Style 9524, designed for applications where toughness, durability or improved resistance to resin crazing is desired. This felt is a carded blend of long crude and long spinning fibers, combined with open weave glass cloth.

No. 9524 Pyrotex felt provides high impact and bursting strength in tubular wound structures. The lack of resin-rich areas reduces the possibility of weepage. Unusually good wet strength facilitates processing under adverse conditions.

Send for this free brochure—please use your company letterhead

RM

RAYBESTOS-MANHATTAN, INC.

ASBESTOS TEXTILE DIVISION, Manheim, Pa.

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RAYBESTOS-MANHATTAN, INC., Asbestos Textiles • Laundry Pads and Covers • Packings • Brake Linings • Brake Blocks Clutch Facings • Fan Belts • Radiator Hose Rubber Covered Equipment • Industrial Rubber, Engineered Plastic, and Sintered Metal Products • Abrasive and Diamond Wheels • Bowling Balls

Eastman plasticizers

dimethyl phthalate
diethyl phthalate
di-(methoxyethyl) phthalate
di-isobutyl phthalate
dibutyl phthalate
di-isobutyl adipate
triacetin
tributyrin
di-(2-ethylhexyl) adipate (DOA)
dioctyl phthalate (DOP)
di-isooctyl phthalate (DIOP)
dioctyl azelate (DOZ)
plasticizer 84
—an octyl butyl phthalate

For highest quality finished products, rely on Eastman plasticizers—made under the most exacting and rigid specifications in the industry. Samples and technical assistance furnished upon request. Also write for our booklet describing Eastman plasticizers and their uses.

Eastman
CHEMICAL PRODUCTS, INC.
KINGSPORT, TENNESSEE
subsidiary of Eastman Kodak Company

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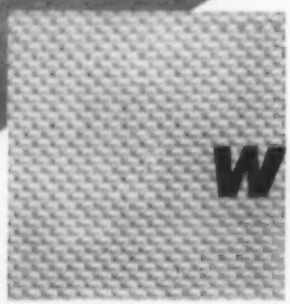
West Coast: Wilson Meyer Co., San Francisco; Los Angeles; Portland; Salt Lake City; Seattle.

"Welkote" backs vinyl with engineered performance!

Coater: H. M. Sawyer & Son Co., Watertown, Mass. Fabricator: Hoosier Tarpaulin Co. of Indianapolis.

The theater tent shown here is something special. It's the Tucson Winter Playhouse, first multi-colored vinyl coated nylon tent in the U. S. Its red-and-white striped top is made with Welkote, the Wellington Sears nylon base fabric which, when properly coated and fabricated, combines lightness and handling ease with unusually high tear-resistance, strength, resistance to oil, rot and mildew. This rugged filament nylon fabric has become the base fabric specified by coaters for tarpaulins, truck covers, and protective coverings for industrial, agricultural and marine uses. Specifically engineered for vinyl and neoprene coating, it is available on a continuous-supply basis, in three basic weights and a wide range of widths. It is backed by the experience of Wellington Sears, with a deep understanding of the special needs of the coating industry, and over a century of serving the fabric needs of all industries. This experience is yours to rely on and work with in all our fabrics, whether you specify Welkote or any one of an unequalled number of base fabrics available for every coating use at Wellington Sears. For further information on Welkote, write Dept. K5.



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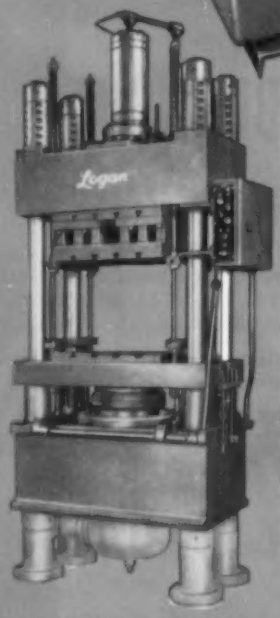

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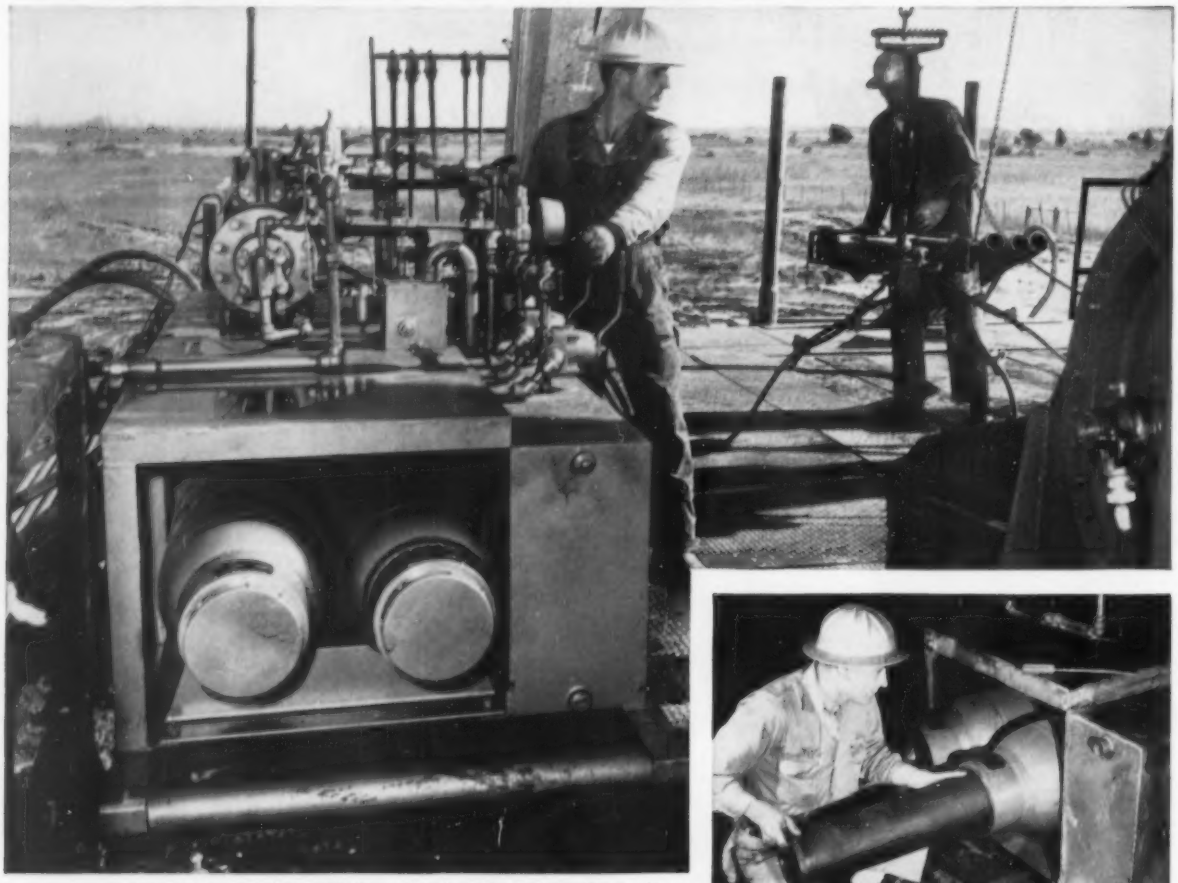

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MODERN PLASTICS
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Wide world of plastics

On the following page begins an editorial project that has long been needed: a series of articles constituting a survey of the plastics industries in the countries listed below.

Two, three, or four countries will be covered in each succeeding issue, and at the end of the series a statistical recapitulation will be published, with maps to show the pattern of world plastics materials progress and the interplay of the powerful economic forces contributing to that progress.

Each article in the series is written either by an editor of a publication serving the plastics industry, by a plastics industry association executive, or by a recognized industry leader in the country concerned. Each article deals with: a) the present status of the industry from the standpoints of materials production, import, and export; b) application trends as related to the specialized needs of the country; c) the growth of the industry at processing level; and d) expansion probabilities for the near future.

As this series of articles flows into print there will be obvious gaps in the quantitative information offered and, indeed, areas of statistical silence. Our authors, all most cooperative in following the desired pattern of presentation, are securing from government, association, and corporate sources all the facts available. But competitive situations, government lethargy, and trade tradition in certain countries mitigate against clarity in industrial information.

It is hoped that one effect of this project will be to encourage ministries in all governments to improve their methods of collecting and presenting plastics industry statistics. The wide world of plastics merits more consideration in this respect because all industry growth anywhere must be measurable.

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Belgium
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Canada
Denmark
France ✓
Germany (West)
Great Britain
Holland
India
Israel ✓
Italy
Japan ✓
Mexico
New Zealand
Norway
South Africa
Spain
Sweden
Turkey

✓ Indicates country covered in this issue

プラスチックス

JAPAN: petrochemical future

*By E. S. Miyamoto**

As late as 1950 there was little in the nature of a plastics industry in Japan. The growth in the past five years has been amazing. There is a definite trend towards mass-production of plastics parts and products in molding and fabricating plants.

As industrialization has progressed in Japan, production has been making great strides. In the years to come the industry will very likely witness a still more remarkable development. Japan produced 345,003,000 lb. of plastics materials in 1955. Assuming that the 1954 production figure was 266,410,000 lb., 1955 production represented a gain of almost 30 percent. (See Table I, p. 91.)

Urea resin in the thermosetting family and vinyl resin in the thermoplastic family are among the most important plastics materials produced in Japan. There are others, of course, but the production of these two has been increasing most markedly.

*Secretary of Institute of Polymer Industry and publisher of Plastics Industry News, in Japan.

Polyvinyl chloride film is rolled over supporting framework to cover a rice bed in Japan. Film speeds maturation of rice, preventing damage by early frost

Thermosetting plastics

Production of phenolic resin in Japan has practically leveled off. Whereas 1953 saw 20,000,000 lb. produced, 1954 saw it slightly increased to 23,000,000 lb., and 1955 to 24,000,000 pounds. Newly developed plastics materials have had a way of crowding out phenolic resin. Phenolic resin makers are also finding it rather difficult to obtain raw materials: phenol and cresol.

They stand a good chance, however, of getting ample materials by the time Japan's projected petrochemical industry becomes established, within the next year or two. There are currently estimated to be from 2000 to 3000 custom molders of phenolic resin, including family-size shops, in Japan. These custom molders, it is estimated, will probably consume approximately 27 million lb. of resin by the end of 1956.

Urea, the basic raw material for urea-formaldehyde resin, had been produced in a large quantity as chemical fertilizer during wartime. We have had little or no trouble in getting it. Twenty-eight million lb. of urea were produced in 1952; the figure jumped to 39 million lb. in 1953, to 62 million lb. in 1954, and still further to 87 million lb. in 1955.

Production and consumption of urea molding materials in Japan are such as is rarely found abroad. There are good reasons for this. Painstaking research has been kept up assiduously. In addition, since Japan has yet to produce polystyrene and cellulosic plastics, urea resin has been serving as a logical substitute for what those materials could accomplish. Although production methods are not discussed, Japanese-made urea has proved to be a superior material from the standpoint of resist-

Table I: Productions of plastics materials in Japan

Material	*1954*	*1955*
	1000 lb.	*1000 lb.*
Phenolic resin		
Molding material	14,608	15,024
Laminates	4,514	4,681
Others	3,998	4,404
Total	23,120	24,109
Urea resin		
Molding material	21,857	27,529
Adhesives	35,913	49,320
Others	4,387	10,250
Total	62,157	87,099
Melamine resin		
Molding material	284	312
Paint use	1,107	1,740
Others	851	3,065
Total	2,242	5,117
Silicone resin	194	341
Polyesters	145	557
Phthalic resin	7,546	10,991
Polyvinyl chloride	48,695	71,282
Polyvinylidene chloride	4,246	4,809
Vinyl acetate (monomer)	26,510	39,105
Polyvinyl alcohol	10,303	15,428
Caprolactum	11,735	20,858
Methacrylate (monomer)	1,993	2,354
Methacrylate (polymer)	1,390	1,322
Cellulose acetate molding material	524	1,298
Nitrocellulose		
for Celluloid	14,689	14,219
for artificial leather	332	400
for lacquer	4,099	4,525
for film	3,711	3,120
for explosives	6,428	4,466
Total	29,259	26,730
Protein adhesives	36,291	33,603
Grand Total	266,410	345,003

ance to moisture and weathering, and in dimensional stability. Japan is probably the only country in the world where telephone housings are molded of urea.

Production of melamine resin in Japan is but two or three years old. Because the material is rather expensive, it is not as widely used as other plastics. Melamine resin etherified by butyl alcohol, however, is used fairly extensively as a protective coating for metal surfaces. Lacquered "geta" (characteristic Japanese clogs) are painted with etherified urea-formaldehyde, modified further with alkyd resin. For this application alone, 2,200,000 lb. of the resin are estimated to be consumed annually.

"Noh" player's mask, used in Japanese theater, is produced from PVC paste resin. (Photo, Kyoto Scientific Specimen Co.)

Ion-exchange resin has been in production for quite a while. Recent demand for it has been steadily increasing from many quarters. Similar intensive interest has been expressed in the newly developed silicones and fluorocarbons.

Reinforced plastics

Glass-reinforced plastics have been in production for about two years now—and demand for the material has been constantly increasing. At present, three concerns produce polyester resins in Japan. (See Table II, p. 92.) Their combined output will shortly be upped to approximately 330,000 lb. a month. By the time Japan's petrochemical industry is firmly established to the point where ethylene glycol and styrene can be produced here (which is but a question of time), the reinforced plastics industry can be expected to make important strides forward.

The end-use breakdown of the various thermosetting plastic materials is shown in Table IV, p. 94.

Thermoplastics

During and after World War II a good deal of "Vinylon" synthetic fiber was manufactured. Since the end of the war, it has been taken up as the key national industry. Consequently, the manufacture of vinyl acetate and polyvinyl alcohol has become a very important industry. Polyvinyl acetate is used to the

Urea-formaldehyde lacquer coatings for tableware are typical of Japan's use of urea. (Photo, Sumitomo Bakelite Co.)

amount of 5 million lb. a year as an emulsion polymer; approximately 4 million lb. are used for copolymerization with vinyl chloride. Vinyl acetate emulsion polymer forms the bases of paints and adhesives, and is also used for sizing Japanese paper.

Both vinyl acetate and vinyl chloride depend on carbide as a raw material. The carbide industry was established during the war for fer-

Table II: Plastics material manufacturing plants in Japan

Name of company	*Location of plant*
Acrylics	
Mitsubishi Rayon Co., Ltd.	Otake,Hiroshima-Pref.
Fuji Kasei Co., Ltd.	Shimura, Tokyo
Musachino Chemical Co., Ltd.	Ogikubo, Tokyo
Caprolactum	
Toa Gosei Chemical Industry Co., Ltd.	Nagoya-City
Toyo Rayon Co., Ltd.	Nagoya-City
Cellulose Acetate	
Dainippon Celluloid Co., Ltd.	Aboshi, Himeji-City
Shin Nippon Chisso Hiryo K.K.	Minomata, Kumamoto-Pref.
Ion Exchange	
Mitsubishi Chemical Industry Co., Ltd.	Kurosaki, Fukuoka-Pref.
Phenolics	
(plants with capacity over 200,000 lb. monthly)	
Hitachi, Ltd.	Taka, Ibaragi-Pref.
Matsushita Electric Works, Ltd.	Monma, Osaka-Pref.
Nihon Yuki Kagaku Kogyo Co., Ltd.	Higashitakatsu, Osaka
Sumitomo Bakelite Co., Ltd.	Terashima, Tokyo
Sumitomo Bakelite Co., Ltd.	Amagasaki-City
Tokyo Shibaura Electric Co., Ltd.	Kawaguchi, Saitama-Pref.
Polyesters	
Nippon Reichhold Chemical Co., Ltd. (Joint ownership—Reichhold Chemical Co., U.S.A.)	Amagasaki-City
Nippon Shokubai Kagaku Kogyo, Co., Ltd.	Suita, Osaka-Pref.
Riken Gosei Jushi Co., Ltd.	Takasaki, Gunma-Pref.
Silicones	
Shinetsu Chemical Industry Co., Ltd.	Isobe, Gunma-Pref.
Tokyo Shibaura Electric Co., Ltd.	Tsurumi, Yokohama-City
Fluorocarbon	
Osaka Metal Industry Co., Ltd.	Ajio, Osaka-Pref.

Name of company	*Location of plant*
Vinyls	
Asahi Dow Co., Ltd. (Joint ownership—Dow Chemical Co. U.S.A.)	Nobeoka, Miyazaki-Pref.
Denki Kagaku Kogyo K.K.	Shibukawa, Gunma-Pref.
Japanese Geon Co., Ltd., The, (Joint ownership—B. F. Goodrich Chemical Co., U.S.A.)	Kambara, Shizuoka-Pref.
Kanegafuchi Chemical Industry Co., Ltd.	Torikai, Osaka-Pref.
Kurashiki Rayon Co., Ltd.	Kurashiki-City
Kurashiki Rayon Co., Ltd.	Toyama-City
Kureha Chemical Industry Co., Ltd.	Nishiki, Fukushima-Pref.
Mitsui Chemical Industry Co., Ltd.	Nagoya-City
Monsanto-Kasei Chemical Co. (Joint ownership—Monsanto Chemical Co., U.S.A.)	Yokkaichi-City
Nippon Synthetic Chemical Industry Co., Ltd., The	Ogaki, Gifu-Pref.
Nippon Carbide Industries Co., Inc.	Uozu, Toyama-Pref.
Shin Nippon Chisso Hiryo K.K.	Minomata, Kumamoto-Pref.
Showa Synthetic Chemical Industry Co., Ltd.	Kanose, Niigata-Pref.
Sumitomo Chemical Co., Ltd.	Kikumoto, Niihama-City
Tekkosha Co., Ltd.	Sakata, Yamagata-Pref.
Toa Gosei Chemical Industry Co., Ltd.	Nagoya-City
Aminos (Melamine and urea)	
(plants with capacity over 200,000 lb. monthly)	
Fuji Kasei Co., Ltd.	Shinjuku, Tokyo
Nisshin Spinning Co., Ltd.	Nishiarai, Tokyo
Riken Gosei Jushi Co., Ltd.	Takasaki, Gunma-Pref.
Sumitomo Bakelite Co., Ltd.	Terashima, Tokyo
Sumitomo Bakelite Co., Ltd.	Amagasaki-City
Toyo Koatsu Industries Inc.	Ofuna, Kanagawa-Pref.

tilizers. The vinyl chloride industry had its birth in Japan by taking advantage of the carbide and chlorine that were made available as by-products from the manufacture of electrolytic caustic soda for the textile and light metal industries. The raw material situation attracted the attention of some industrialists who hit upon the idea of making all Japanese vinyl polymers from acetylene.

Production of polyvinyl chloride continues to hike phenomenally year after year. The 19 million-lb. production figure in 1952 jumped to 30 million lb. in 1953, to 48 million lb. in 1954, and then to over 71 million lb. in 1955. In the early days, emulsion polymerization was chiefly used; today, this technique has been practically supplanted by suspension polymerization. In the pioneer days, vinyl resin had to be imported, but since 1954, importation has practically ceased. (See Table III, right.) Recently, in addition to resins for general purpose, resins for rigid products, such as phonograph records, paste resins, and other types are being produced.

Table III: Japanese foreign trade in plastics

Material	*1954* *1000 lb.*	*1955 (estimate)* *1000 lb.*
Imports		
Cellulose acetate	446	1760
Coumarone-indene	468	440
Epoxy resin	105	100
Fluorocarbon	1500	660
Ion exchange resin	345	264
Methacrylate (scrap)	572	440
Phenolics	453	220
Polyesters	142	?
Polyethylene	3322	7700
Polystyrene	4103	6600
Polyvinyl chloride	264	100
Silicone	163	300
Styrene monomer	105	100
Exports		
Phenolics	54	73
Urea resin	250	130
Polyvinyl chloride	1245	5526
Polyvinyl acetate	8	660
Methacrylate	4	?

Film and sheet

Techniques in PVC processing have also seen considerable improvement in Japan. The reverse-L calender is now accepted as standard processing equipment for the production of film and sheet.

Film and unsupported sheet, up to 72 in. wide, have been made for several years. Using a calender, sheeting can be thinned down to 0.05 millimeter. For raincoat applications, however, film 0.13 to 0.15 mm. thick is used. Some manufacturers have succeeded in turning out a flat film 54 in. wide and 0.025 mm. thick by extruding through a T-die.

Rigid vinyl

PVC films have played a star role in agricultural applications in Japan. As coverings for rice seedbeds, PVC films have proved invaluable as a means of speeding up the maturing of rice and thus enabling farmers to beat early freeze-up. As seashore salt bed sheets they have proved equally as useful.

Rigid vinyl products also play an important role in the Japanese PVC industry. The vacuum forming process has seen steady improvement, but the advances shown by rigid polyvinyl chloride pipes have been nothing short of marvelous. More than a million pounds of PVC are made into rigid pipes in Japan every month. They are used as city water mains, chemical

"Kotatsu" (foot-warmer) over-board is produced of picturesque melamine decorative laminate. (Photo, Sumitomo Bakelite Co.)

Table IV: Estimated consumption of plastics materials in Japan, by end use, in 1956*

Material	*1000 lb.*
Phenolic	
electric industry	12,100
communication industry	4,950
rolling stock	2,970
textile industry	1,980
paint	2,420
misc.	2,860
Total	27,280
Urea-formaldehyde	
container, closure caps	7,700
tableware	5,060
button	3,740
machinery parts	3,080
electric utensil parts	1,540
sundries	4,840
adhesive	45,100
paint and other uses	5,940
Total	77,000
Polyvinyl chloride	
unsupported film	19,800
sheetings	10,120
supported film	13,200
extruded goods	5,280
other flexible goods	1,100
rigid pipe	23,760
rigid plate	11,880
rigid molded goods	3,300
electric covering	14,520
paint	1,320
synthetic fiber	—
export	8,800
Total	113,080
Methacrylate	
radio parts	264
electric lighting fixtures	418
automobile parts	264
machinery parts	330
airplane parts	44
building material	330
sundries	594
paint	242
misc.	154
Total	2,640

Material	*1000 lb.*
Silicone	
varnish	396
oil and emulsion	66
grease and compound	88
rubber	44
misc.	66
Total	660
Fluorocarbon	
wire covering	22
chemical packing	66
chemical pipe	44
film & tape	88
sheet	66
processing rod	22
lining	110
electric parts	22
Total	440
Polyesters	
pipe	792
rolling stock & ship industry	616
building material	264
coating	132
electric communication	110
misc.	286
Total	2,200
Polystyrene	
electric instrument parts	660
communication instrument parts	1,540
other industrial parts	1,100
sundries	4,180
molded goods for export	1,320
Total	8,800
Polyethylene	
wire covering	1,760
packaging film	5,500
bottle & other molded goods	2,200
pipe	1,540
Total	11,000
Alkyd	
primarily for paint material	13,640
Cellulose acetate	
molding material	6,820

*From Plastics Industry Five-Year Plan, MITI.

plant and hot spring ducts, for irrigating or draining truck and horticultural gardens, and in building and other applications. One of the latest applications of polyvinyl chloride is the recently introduced rigid and flexible vinyl sponge. Such sponges come in particularly handy as fishery net buoys for the extensive fishing industry in Japan.

Polyvinylidene chloride in monofilament form is a valuable material for synthetic textiles. Table II, p. 92, lists the manufacturers of polyvinyl acetate, polyvinyl chloride, and polyvinylidene chloride under the heading of Vinyls.

Caprolactum is used as a base for polyamide synthetic fibers. Cellulose acetate is used primarily for acetate rayon. These materials are expected to develop gradually into more prominent positions.

Petrochemical future

Japan's petrochemical industry has been under contemplation since 1954. The plastics industry of this country differs slightly from that of Europe and America, since coal and carbide and not petrochemical products have always been the principal source of raw materials for plastics in Japan. The situation being what it is, the production of phenol-formaldehyde and cresol, and polyester resin is up against the shortage of petrochemical materials; methacrylate production is in need of acetone.

Making acetone cyanhydrin available has been the starting point for Japan's methacrylate production thus far. Methyl methacrylate, which can be made in Japan from petrochemicals has a big future—and it is here that the petrochemical industry can be of tremendous assistance.

What the plastics industry is most interested in, from the petrochemical standpoint, are styrene and ethylene. Japan imported polystyrene to the extent of 286,000 lb. in 1951, 1,220,000 lb. in 1952, 4,100,000 lb. in 1953 and 1954, and in 1955 it is estimated as 6,600,000 pounds. As for polyethylene, Japan imported 70,000 lb. in 1951, 693,000 lb. in 1952, 1.3 million lb. in 1953, and 3.3 million lb. in 1954, with 7.7 million lb. estimated for 1955. Demand for these two resins has been quite brisk—a fact the petrochemical industry can ill afford to lose sight of. (See Table III, p. 93.)

Arrangements for starting the petrochemical industry in Japan have been steadily assuming definite shape. By the end of the 1956 fiscal year, it is estimated that plants will be turning out 38 million lb. of polyethylene and 6.6 million lb. of polystyrene a year. In that fiscal year, 15,400,000 lb. of polyethylene are expected to be imported. Only when the petrochemical industry gets going, can Japan's plastics industry function properly.

Extruded rigid polyvinyl chloride strips replace the traditionally used bamboo in Japanese roll-up window blinds

Table V: Number of injection molding machines in Japan[a]

	1955[b]	1954	1953	1952
Number of machines	over 600	557	411	126
Total capacity (oz.)	over 3000	2652	1370	529

[a] Information on other plastics processing machines not available.
[b] Estimated figures.

FRANCE: advanced techniques

*By J. Combette**

In France, coal or carbon chemistry, to a much greater extent than petrochemistry, constitutes the present source of raw materials and intermediates for the production of plastics. The two main centers of carbon chemistry in France are Mazingarbe, in the north, and Carling in the northeast, in Lorraine. Another center is the Lyon region, where the first European plant for the industrial production of phenol and acetone from cumene was built.

Petrochemistry is, however, starting to develop, and is beginning to provide, for example, solvents prepared from refinery gases. The enormous gas deposits of the southwest should prove to be a great new source of raw materials.

The French resin industry is becoming practically independent with regard to most of the basic materials. It will soon produce styrene and acrylonitrile for plastics; it already produces acrylonitrile for fibers.

French production of plastics rose from 22,000 metric tons in 1949 to 95,000 metric tons in 1955 (a metric ton is 2204.6 lb.). In 1953, the annual consumption of plastics per capita was 1.35 kg; in 1955, it was 2.5 kilograms.

France still imports twice as much plastics as it exports. Its main suppliers during the past year have been the United States which sold it 5000 tons of material (primarily polystyrene, polyethylene and cellulose acetobutyrate), Germany (4600 tons), and Great Britain (4500 tons). All the ordinary types of resins are produced on French soil except for polyfluorethenes, cellulose acetobutyrate, and certain special grades of various resins.

At least two plants are soon going to start the production of low pressure polyethylene.

The total monies involved in the French plastics industry in 1955 was estimated at 135 billion francs (28¾¢/100 francs). This breaks down into 30 billion francs spent for resins and in the manufacture of tools; 65 billion for cost of molding and processing of the plastics; and the balance representing distributors' profit on the sale of the finished products.

*Editor-in-chief, *Industrie des Plastiques Modernes*

Phenolics

Total French consumption of phenolic in 1955 in the form of semi-finished commercial products was about 17,200 metric tons. Molding represented 55% of that total.

A constant increase in electrical, industrial, and appliance applications of molded phenolics has been augmented by the development of shock-resistant phenolic molding materials which frequently replace cast iron or stamped metal in product design.

Decorative laminates progressed very rapidly in 1955; electric laminates, however, seem to have remained stationary.

Sales of emulsions and solutions for various compositions, particularly adhesives also grew in volume.

Phenolic binders for foundry sand are being widely advertised and the demand for them is already increasing for 1956.

Amino resins

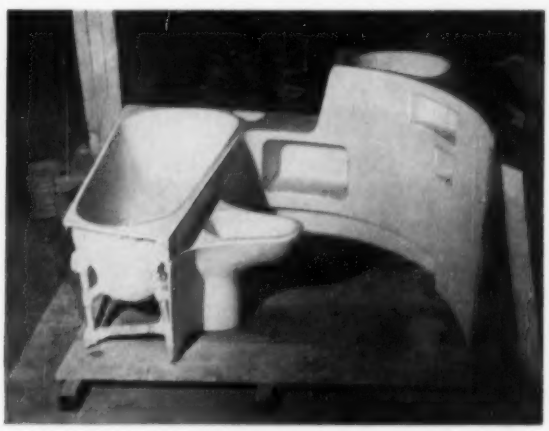
France produced 10,550 metric tons of amino resins in 1955, including 2700 tons of urea and melamine molding powders. It is estimated that a maximum of 200 tons of melamine powders were molded, as compared with 2500 tons of urea. Consumption of amino resins almost tripled between 1952 and 1955.

Reinforced polyesters

In 1955, about 15 French producers supplied 910 metric tons of polyester resins while about 140 metric tons were imported, making a total

France's all plastics house: outer walls consist of styrene foam core-polyester skin sandwiches; interior walls are of polyester sheet, floors of phenolic-impregnated paper honeycomb construction

Mold, 12½ ft. long, for load-bearing frame and floor, is one of 25 molds used for French house



Bath tub, bidet, and sink for bathroom of plastics house are molded in one piece

Ceiling-roof with several sections in place. Sections lock together with fins that double as rain gutters. Central pipe serves as support for the plastics house as well as drain for rain and household waste

Plastics producers in France

Phenolics

La Bakelite of Bezons (Seine-et-Oise)
R.V.A. of Clamecy (Nievre) and of Lyon (Rhone)
H.G.D. of Vendin le Vieil (Pas-de-Calais)

Aminos

Cie Francaise des Matieres Colorantes of Villers St. Paul (Oise) (urea)
R.V.A. (melamine, urea) of Lyon (Rhone) and Clamecy (Nievre)

Polyesters

R.V.A. of Lyon (Rhone)
St. Gobain of Chauny (Aisne)
Rhone Poulenc of St. Fons (Rhone)
Houilleres du Bassin du Nord et du Pas de Calais of Bruay (Pas de Calais)
Convert of Oyonnax (Ain)
La Nobel Francaise of Stains (Seine)
Petitcollin of Monville (Seine-Inferieure)
Beckacite of Bezons (Seine-et-Oise)
Sheby of Bergerac (Dordogne)

Acrylics

Alsthom of Bernouville (Eure)

Cellulosics

Rhone Poulenc of Peage de Rousillon (Isere)
La Bellignite of Bellignat (Ain)
Convert of Oyonnax (Ain)
Petitcollin of Monville (Seine-Inferieure) and Etain (Meuse)
La Nobel Francaise of La Riviere St Sauveur (Seine-Inferieure)

Polyamides

Rhodiaceta of Lyon
Oranico of Marseille (Bouche-du-Rhone)

Polyethylene

Ethylene Plastique of Mazingarbe (Pas-de-Calais)

Polystyrene

Pechiney of Ribecourt (Oise) (Erinoid)
Monsanto-Boussois of Wingles (Pas-de-Calais)
H.G.D. of St. Nazaire (Loire-Inferieure)
R.V.A. of Lyon (Rhone) (BASF)

Polyvinyls

Pechiney of St. Auban (Basses-Alpes)
Solvic of Tavaux (Jura)
St. Gobain of Montlucon (Allier) and St. Fons (Rhone)
Rhone Poulenc of St. Fons (Rhone) and of Peage de Roussillon (Isere)
Kuhlmann of Brignoux (Isere)

Silicones

Rhone Poulenc, Les Carrieres St. Fons (Rhone)
St. Gobain of St. Fons (Rhone)

consumption of 1050 tons. This level is almost six times higher than it was in 1954.

Fibrous glass used with polyesters amounted to 785 metric tons in 1955, compared with 300 tons in 1954. Thus, total finished parts and products of reinforced plastics in 1955 amounted to over 1900 tons, if fillers are included.

Reinforced plastics molders are tooling up for mass production. A number of large platen, low-pressure molding presses have been brought into the shops and it is reported that there were at least six preforming machines in operation in France in 1955.

Almost two-thirds of the polyester resins sold are used for the production of translucent corrugated panels. There are some 8 producers in France today. These turned out approximately 400,000 square meters of paneling last year.

Molded tool applications, which rank second in use of low-pressure laminates, absorbed one-eighth of the polyester tonnage. The year 1955 marked the start in France of this trend towards plastics in metal-forming tools and tools used in the molding of reinforced plastics parts.

Finally, reinforced plastics are moving into the consumer market. Forty tons were used in fishing rods, with great success.

Styrene plastics

French consumption of styrene in 1955 amounted to 12,340 metric tons, or scarcely 300 tons more than in 1954. Exports represent 16% of production. There were increases in the sales of styrene wall tiles, advertising displays, and automobile components. Various housewares and toys received competition from those made of flexible polyethylene.

Polystyrene production capacity will cover practically all French requirements by the end of 1956, both for regular polystyrenes and for improved high-impact materials in the alloy and copolymer categories. A new producer (the fourth) is starting manufacture in April 1956.

Polyethylene

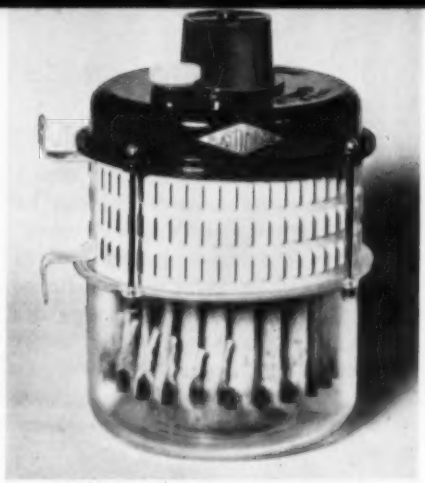
France consumed 1300 tons of polyethylene in 1953, 5500 tons in 1954, and 6780 tons in 1955—more than quintupled in three years.

Plastics processing equipment in France

Equipment	*1954*	*1955*	*1956*
Molding, extruding, and fabricating plants	3100	3200	3300
Injection molding machines	3324	4036	4700
Compression molding presses	3700	3900	4000
Extrusion machines	2300	2500	2700

The national production and the imports are not yet sufficient to meet the demand. Nevertheless, actual production capacity in Jan. 1956 was about 6000 tons; it will be increased to 8000 tons by July 1956. Already in the planning stage is the construction of three low-pressure polyethylene plants in France.

It is estimated that monthly demand in France for polyethylene for the first half of 1956 will be 1200 tons. Consumption in 1955 was 23% greater than the previous year. Virtually all polyethylene applications showed a healthy growth pattern. Unfortunately, they have been greatly retarded by the lack of sufficient material.



French-produced filter for automotive use includes components molded of polyethylene and styrene

Cellulosics

Consumption of cellulosics in 1955 was 5700 metric tons—1000 tons of nitrate, 4000 tons of acetate, and 700 tons of butyrate. Production of cellulosics was 4800 tons, of which 3800 was acetate.

Distribution of the cellulosics was as follows:

	1954	*1955*
Molding powders	38%	44%
Sheets, rods, and tubes, sundry profiles	35%	33%
Cast films	27%	23%

As extruded film is developed, however, the percentage of end-use applications will undoubtedly change again.

Polyamides

Polyamides consumed in France in 1955 reached a level of 1418 tons. This increase in tonnage (800 tons in 1954) is due to the development of new techniques and also to a substantial increase in the 1955 production of the more recent of our two polyamide producers. This same producer further announces that it is going to quintuple total sales (textiles plus plastics) in 1956.

The bulk of export is to Switzerland (1388 tons); smaller amounts (on the average, 130 tons each) go to Brazil, Spain, and the Belgium-Luxembourg Economic Union. In one year, exports stepped up from 1060 tons to 1826 tons, an increase of 72 percent.

For 1956, there can be forecast a continuous increase in molded articles and industrial parts and also a large increase in molded nylon bottles as well as sheets for all types of packaging. Indeed, France is a pioneer in the packaging of food in polyamide film. A film of 0.04 mill can be sterilized and has a mechanical strength equal to another plastic sheet of much greater thickness.

Polyacrylic resins

French manufacturers in 1955 delivered 985 metric tons of acrylic sheets. As these manufacturers did not produce molding powders, it was necessary to import the 150 tons required for molding demands.

Polyvinyl resins

French producers supplied 32,200 tons of dry polyvinyl chloride resins in 1955. They also exported 3790 tons and imported 2272 tons thereby accounting for a total French consumption of 30,702 tons of polyvinyl chloride resins.

The total consumption of vinyl resins of all types is at a rate of 36,834 tons per year.

We have been able to determine rather accurately the distribution according to the fabricating technique used of the 29,000 metric tons sold in Metropolitan France in 1955 by the producers (in metric tons):

Calendering			48% or 14,000 tons
Extrusion:			
Cables	12%	3500 tons	19.5% or 5600 tons
General extrusion	7.5%	2100 tons	
Coatings			12% or 3500 tons
Rigid semi-finished products:			
Plates	2.8%	800 tons	5.6% or 1600 tons
Tubes	2.8%	800 tons	
Molding			6.5% or 1900 tons
Production of fibers			4.5% or 1300 tons
Miscellaneous (coverings, plastigels, etc.)			3.9% or 1100 tons

Thus in 1955, as in 1954, one-half of the

polyvinyl chloride (calculated as dry resin) passed between calender rolls. There can be noted a certain stagnation of the "extrusion" item, but a renewed advance is expected in 1956 as plants producing very thin sheets go into operation. On the other hand, coating has advanced, undoubtedly because of the higher qualities which the customers demand of the sheets. The rigid semi-finished products have doubled in tonnage. Chemical and parachemical industries, in particular, have made their needs felt for anti-corrosive materials (polyvinyl chloride pipes and fittings); water line systems also tend to absorb a certain amount of piping.

Molding also took a big step forward. Included in this category are injection molding proper, compression molding of phonograph records (copolymers), and the molding of plastisols and alloys into hollow objects, shoe parts, etc.

Vinyl textiles assumed a leading role in the development of the vinyl chloride industry in France in 1955.

Prospects for vinyl

What are the probable trends in vinyl for 1956? The tonnage of polyvinyl chloride for cable insulation will probably increase, since the quality of all the resins is continuously improving. In all probability there will soon appear a certain amount of flexible insulated wire for domestic construction. The molding of microgroove phonograph records is also increasing.

The copolymers which have become of major importance in the record industry will undoubtedly be used as a base for paints and adhesives (e.g. in the form of maleate-acetate-chloride tripolymers). Also expected is an increase in moldable mixes for shoes and the manufacture of relatively thick parts. Garden hose is expected to reach a figure of 10,000,000 meters, which would represent 1300 tons of extruded material. In this connection, there are certain persons today who foresee a situation of sharp competition between calendering and extrusion.

In the field of coating, an increase in the tonnage processed will be noted if automobiles and heavy vehicles resolutely direct their attention to plastics for the covering of seats and doors and if the office furniture industry, the shoe industry, and a few other fields of use continue to adopt coated fabrics. The clothing industry in all probability also will be interested in coated fabrics.

Research and standards

About twenty large plastic producers in France have been expending considerable effort both on quality improvement and on new product research. The Centre d'Étude des Matières Plastiques (Plastic Research Center), the director of which is also the head of the Plastics Department of the Conservatoire National des Arts et Métiers (National Conservatory of Arts and Trades), has been supervising the operation of the "Marque de Qualité" (Quality Product) insignia for thermoplastic resins since the last war. This agency is in charge of the standardization of plastics in France.

Its activity, combined with the activities of the large companies and that of the Syndicat des Fabricants de Resins Synthetiques (Synthetic Resin Manufacturers Association) and the Union des Syndicats de la Transformation des Matières Plastiques (Federation of Plastic Processors' Associations) has contributed towards improving the quality of the technical and commercial products. The large Exhibitions and the conventions organized by *Industrie des Plastiques Modernes* or the Union des Syndicats have greatly assisted in attracting the attention of manufacturers and the public at large to plastics.

Plastisol sprayed on aerosol perfume bottle of glass (right) prevents glass fragments from scattering in case bottle explodes

ISRAEL: study in versatility

*By Tuvia Bar-Ilan**

From its initial start two decades ago with a few hand-operated presses, Israel's plastic industry has progressed to the point where it now manufactures its own phenolic molding powder, compounds all the required polyvinyl chloride from the basic ingredients, and utilizes some 1000 tons of mixed resins annually, in a total of 68 plants.

Most of the plants are hardly more than workshops, but a respectable number are up-to-date establishments with modern equipment of both European and American design. Compression presses range from small automatic units to a 350-ton unit, and there are injection machines up to 24-oz. capacity (the majority are in the ½- to 4-oz. capacity range). Extrusion machines of both single and double screw construction range up to a maximum of 3½ in., with larger sizes expected during the current year. At time of writing there are 26 injection machines, 63 compression presses, one calender, and 21 extruders operating in Israel.

Many of the plants commenced operations with a stock of imported molds. The larger plants now have their own tooling facilities, but the great majority order their dies from local die-making specialists.

Because of the small consumer market in Israel, and consequent short runs, many molds have been of inferior design and finish. This problem is now being overcome with the help of a progressive government policy and technical advice and guidance from UNESCO and USOM specialists.

Compression molding

Electrical fittings and industrial parts have had a good volume market in Israel from the beginning. In consumer goods, both phenolic and urea are molded into large numbers of toilet seats, housewares, and novelties. Melamine, however, has up to now been slow in finding large-scale consumer acceptance as a material for tableware.

Serafon Resinous Chemicals Corp., in a plant built with American "know-how," furnishes the molders with all the phenolics they require—about 300 tons a year. The plant actually has a much larger capacity, however. Recently, large quantities were exported to Greece with good results.

Injection molding

Injection molding was introduced somewhat more than a decade ago for the manufacture of toys and novelties. The principal resin was, and still is, polystyrene. In many cases, however, molded styrene end-products proved unsatisfactory, primarily because of bad mold design and misapplication. Two firms, Yarkon Plastic Products, Ltd. and Geller, Gartenberg, and Teicher, have replaced regular styrene with the tougher styrene alloys and copolymers in manufacturing housewares, refrigerator door liners, and other industrial articles, with notable success.

Yarkon Plastic Products, Ltd. also pioneered in the molding of polyethylene housewares. In addition, it manufactures polyethylene bottles by the Swiss Novoplast injection-blowing method. Dura Ltd., a firm with Canadian connections, is now concentrating on polyethylene housewares and on packaging applications. Generally speaking, polyethylene is replacing styrene in ever-increasing quantities and consumer reaction to molded polyethylene products is enthusiastic.

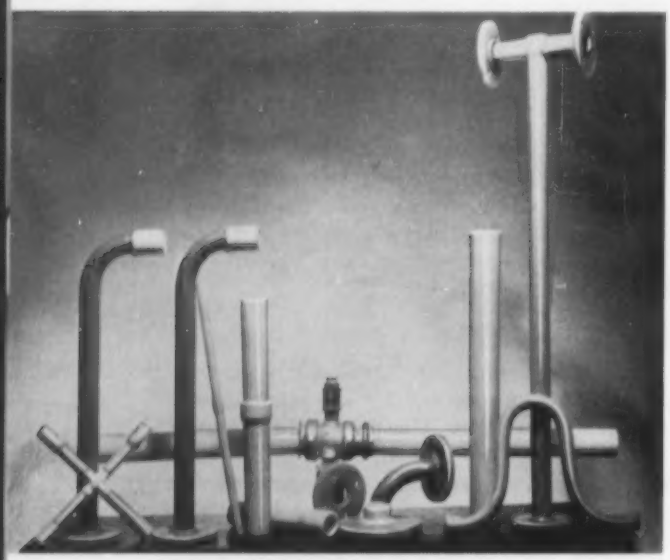
Cellulose acetate is used mostly in the molding of novelties and toys. Its usage has not increased recently but it is holding its own. One

*U. S.-Israel Plastics Corp.

firm, Ben Tzur and Drouianoff, has been especially successful in injection molding acetate goggles and a respectable export market has been found for them. Geller, Gartenberg, and Teicher is the only firm that molds automotive bushings and other industrial products from polyamides.

Extrusion

About half of the total resin now being consumed in Israel is polyvinyl chloride. This is being compounded locally by U.S.-Israel Plastics Corp., a wholly American owned firm, and



Several examples of unplasticized polyvinyl chloride tubes and fittings produced in Israel by U.S.-Israel Plastics Corp.

Haifa Plastics Ltd., from PVC virgin resins and plasticizers, mostly dioctyl phthalate, imported from half a dozen European countries, the United States, and Japan. Carmit Ltd. manufactures three Argus stabilizers under a license arrangement.

Among the volume users of PVC compounds in Israel are five cable coaters who together consume about 250 tons annually. There is a marked tendency to replace rubber with PVC (and, to a minor extent, with polyethylene) in sheathing electric wire and cable. One company, Cables of Zion, Ltd., had notable success in developing a 30 mm. "antigron" cable, which consists of four 35-sq. mm. PVC-coated copper wires, a special rubber composition filling, and a heavy PVC top layer in different colors. The result was so satisfactory that an export order for 100 km. of the cable was recently placed with the firm.

Large quantities of PVC find their way into garden hose, which is currently being extruded by four Israeli firms and which has virtually replaced rubber hose.

The U.S.-Israel Plastics Corp. is one of the few firms known to extrude rigid and semi-rigid sheet, 1 yd. wide, on a commercial basis. It also turns out 22-mil flexible sheeting, 50 in. wide. The former is used in industrial plants for vessel and tank linings, and the latter is embossed and sold to a host of handbag and novelty manufacturers. The firm also extrudes unplasticized and rigid PVC tubes and rods. The former are used mostly by the chemical industry and the latter by the electrical industry and by novelty as well as pen manufacturers.

About a mile of 2-in. unplasticized tube has been conveying acids through the large Fertilizers and Chemicals Ltd. plant in Haifa for the past year.

U.S.-Israel Plastics Corp. has also been a pioneer in the extrusion of blown polyethylene flat tubing in all the various commercial sizes and gages.

United Saran Plastic Corp., another firm operating with American "know-how," is successfully extruding saran monofilament for automobile upholstery and for screening. Cellulose acetate and polystyrene are also extruded by several firms in the form of industrial tubing.

Coating and emulsions

Mayer Chemical Industries uses plastisols for coating kraft and impregnated papers as well as cotton drill and sheeting with PVC. Serafon Resinous Chemicals Corp. specializes in fabric coating by means of the organosol process. Both firms coat, emboss, and silk-screen some 350,000 running yards of fabrics and 700,000 running yards of paper per annum. Of the latter, some 100,000 running yards are impregnated previous to the coating process with copolymeric aqueous latices. The coated fabrics are made mostly for upholstery application and a variety of decorative purposes; coated paper has its widest usage in the bookbinding field.

These same firms have lately been poly-

Plastics manufacturing and processing plants in Israel

Name of company and location	*Technique*[a]	*Material*[b]	*Product*[c]
Ambit, Pardness Hana	COMP,INJ	CA,ME,PE,PH,U,S	B,H,I,N
Ampliton, Jerusalem	EXT	PVC	C
Avnaak, Hadar-Ramatayim	EXT	PVC	C
Ben Tsur and Drouianoff, Tel Aviv	COMP,INJ	CA,ME,PE,PH,S,U	H,I,N,T
Cables of Zion, Rishon L'Zion	EXT	PVC	C
D.I.G., Jaffa	COMP	PH,U	EF
Dayagi Bros., Tel Aviv	FOR	MMA	N
Dura Ltd., Jerusalem	INJ	CA,PE,S	H,I,T
Electro-Barak, Herzlia	COMP	PH,U	EF
Electro-Netech, Petach Tikva	COMP	PH,U	EF
Geller, Gartenberg & Teicher, Bnei-Brak	COMP,INJ	CA,ME,PE,PH,S,U	H,I,N
G.G., Jaffa	COMP	PH,U	EF
Graelit, Tel Aviv	COMP	ME,PH,U	H,I
Grauweiss, Tel Aviv	INJ	CA,S	H,N
Haklit, B. Rabinowitz, Haifa	COMP	ME,PH,U	H,I
Haogen, Mishmar Hasharon	EXT,CAL	PVC	GH,SH,F
Hayozem, Jaffa	COMP,INJ	PH,U,S	I,T
Hirschberg, E., Tel Aviv	COMP	PH,U	EF
Heliot, Haifa	COMP	PH,U	B
Huliot Plastics Industry, Sdeh Nehemia	FOR	MMA	H,N
Israplast, Tel Aviv	COMP	PH,U	EF
Keter, Jaffa	INJ	CA,S	N
Kivke, Tel Aviv	COMP	ME,PH,U	H
Lafsil Plastic Products, Tel Aviv	COMP	ME,PH,U	H
Mayer Chemical Industries, Petach Tikva	COAT,SYN	PVC,VA	CF,CP,VA
Microplas, Holon	EXT	PVC	C,TR,I
Mishmar Haemek, Mishmar Haemek	COMP	PH,U	EF
Modern Plastics Mfrs., Tel Aviv	EXT	PVC	I
Palbutton, Tel Aviv	COMP	CAS,U	B
Palestine Electric Wire, Haifa	EXT	PVC	C
Plastics Israel, Tel Aviv	INJ	CA,PE,S	N
Plastics Haifa, Acre	COMP,EXT	PH,U,PVC	I,GH
Plir, Jerusalem	INJ	CA,PE,S	H,T
Roleo Stern, Haifa[d]	INJ,EXT	CA,PE,PVC,S	H,I,N
Serafon Resinous Chemicals, Rehovot	COAT,SYN	PVC,VA	CF,PH,VA
Shevet, Ramat Gan	EXT	PVC,CA,S	GH,I
Sidi Plastics, Jaffa	COMP	PH,ME,U	B
Superplast, Petach Tikva	COMP,INJ	PH,ME,S	H,I
Technoplast, Tel Aviv	COMP,INJ	PH,ME,S	H,I
United Saran Plastic, Rehovot[e]	EXT	SA	MF
U. S.-Israel Plastics, Holon[f]	EXT	PVC,PE	F,I,SH,TR,GH
Weissbord, Tel Aviv	COMP	PH,U	EF
Yarkon Plastic Products	INJ	CA,PE,S	H,I
Zitor, Holon	COMP	PH,U	EF

[a]*Key: Technique*
CAL=calendering
COAT=coating
COMP=compression
EXT=extrusion
FOR=forming
INJ=injection
SYN=synthesis (chemical)

[b]*Key: Material*
CA=cellulose acetate
CAS=casein sheets
ME=melamine
MMA=methyl methacrylate sheets
PE=polyethylene
PH=phenolics
PVC=polyvinyl chloride
S=polystyrene and copolymers
SA=saran
U=urea
VA=vinyl acetate emulsion or monomer

[c]*Key: Products*
B=buttons
C=electric cable
CF=coated fabrics
CP=coated paper
EF=electric fittings
F=film, lay-flat tubing
GH=garden hose
H=household items
I=industrial items
MF=monofilaments
N=novelties
SH=sheeting
T=toys
TR=tubes and rods

[d]Daughter company of firm with same name in Paris.
[e]Partly owned by National Plastic Products Co., Odenton, Md.
[f]U. S.-Israel Plastics Corp., Holon, is an American company, registered in New York State.

Consumption of plastics materials in Israel

Material	*1955*	*1956 (Estimated)*
	1000 lb.	*1000 lb.*
Acrylics	6	6
Cellulosics	90	100
Fluorocarbons	—	—
Nylons	—	—
Polyethylenes	85	200
Styrene polymers	400	500
Polyvinyl chloride	900	1600
Vinyl acetate emulsion	300	900
Amines (melamine and urea)	200	350
Phenolics (molding, laminating, and industrial resins)	600	600
Polyesters	—	5
Epoxies	—	—
Total	2581	4261

merizing vinyl acetate from imported monomer for use in paints, adhesives, and textile sizings.

Miscellaneous

Huliot Plastics Industry is the largest of the Israeli firms processing methacrylate sheets into housewares and novelties. Several firms have purchased vacuum forming apparatus, but so far no products have appeared on the market. However, developments in this process method are expected in the not too distant future.

A new firm, Reinforced Plastics Ltd., has recently introduced polyester products into the market.

A large rubber firm, Haogen, manufactures large quantities of PVC sheeting and film on a rubber calender.

Organization and research

Most of the important compression and injection molders in the country are organized in the Israel Plastics Union, a subsidiary of the Manufacturers' Association of Israel. The extruders are organized in the Association of Extruded Plastics Manufacturers. Both organizations represent the manufacturers before the Government, deal with raw material imports and allocations, and regulate, wherever necessary, the internal relationships between competing firms.

The Association of Plastics Research was recently formed under the auspices of the government, the Israel Standards Institute, and the Weizmann Institute of Science. Applied research will be done on the premises of the Weizmann Institute of Science, mostly with newly acquired equipment and apparatus whose purchase has been largely made possible by a point 4 grant.

The Weizmann Institute of Science also does valuable development and research work in its Dept. of Polymer Research, headed by its brilliant Prof. Ahron Katchalsky. Pure research is being done at the present time on water-soluble ionizable polymers like polymethacrylic acid, polymeric vinyl amine, and similar acids and bases, their copolymers, and amphoteric polyelectrolytes.

Applied work is being done in developing new bromine-containing resins and copolymerizing known bromine-containing monomers, such as vinyl bromide, with styrene, methyl methacrylate, etc. This research is especially important to the Israeli economy because of the tremendous bromine reserves that are available in the Dead Sea.

The manufacturers are ably helped and guided by Dr. A. Markowitz, Head of the Dept. of Chemicals in the Ministry of Commerce and Industry, and by his assistant, Mr. Yehoshua Levy, Head of the Sub-department of Plastics. There is a feeling that important things are being done and that plastics in Israel has just begun to come into its own.

Around the world in plastics

*by Robert Ernst**

If I were asked to name the most important thing I learned from my recent 50,000-mile world tour of plastics industries in 18 countries, it would be this: Our foreign friends in all lands appreciate and greatly desire American "know-how," but they don't want it as a present: they want credit arrangements to pay for it and they want to contribute to its further development.

Naturally there are problems involved in present currency restrictions in many countries, but there is nevertheless a widespread desire to get ahead with the job of building a plastics industry and a desire to find some means of recompense for American cooperation.

In general, the eyes of the world are focused on progress in the United States, particularly the recent new developments in polyethylene, improved techniques of vacuum forming, advances made in foamed plastics materials, and the great strides of the reinforced plastics branch of the industry.

The doorway to my travels was Los Angeles, from whence I traveled to Hawaii and from there via the Fiji Islands to New Zealand, Australia, Indonesia, Malaya, Singapore, India, Pakistan, Egypt, Italy, Spain, Switzerland, France, Germany, Sweden, Denmark, Holland, Belgium, and England.

New Zealand and Australia

Two major problems face the industry in New Zealand. First, more plastics materials and more plastics processing facilities are needed to produce the large quantities of goods required to improve the standard of living. Second, there is a serious shortage of skilled labor. As labor is trained, the plastics industry in New Zealand may grow to large new proportions, particularly since there is an abundance of natural resources.

Australia presents an interesting challenge to the American plastics manufacturer. Geographically it is the size of the U. S., but has a total population about that of New York City. The temperament of the Australians may be compared to that of the Americans, rather than to the British. A large portion of the country relies on U.S. developments and commerce rather than on England because of the close links which were created between the two countries during and after the last war, the advancement of American techniques, the readiness of the American manufacturer to lend a helping hand, and many other pertinent factors. About 500 American companies have interests in Australia of one kind or another and the total investments were close to $1 billion last year.

Actually, the plastics field offers the greatest promise of all industries in Australia. Already chemical companies in the United States and Britain have been working (*To page* 224)

*Manager, Plastics Div., Omni Products Corp.

Robert Ernst

The Author

The author of the accompanying article, Robert Ernst, is Manager of the Plastics Div. of Omni Products Corp.

The Omni organization is unique in the world of plastics, comprising as it does affiliate companies in Argentina, Austria, Brazil, Canada, Chile, Colombia, England, Germany, Japan, Mexico, and Venezuela, and resident representatives in many other countries. The company not only does combination export management for many American material makers and machinery manufacturers; it also offers engineering services and negotiates "know how" contracts all over the world.

Why frames of extruded acetate?

Low costs, dimensional stability, fast delivery dates and inherent decorative possibilities are some of the answers

Spearheaded by improved formulations and by the development of special decorative effects, sales of extruded acetate optical sheet have, within the past two years, shown one of the largest percentage gains of any sheet grade. It is estimated that, in 1955 alone, sales of extruded acetate for the manufacture of spectacle frames were up 75% over 1954—and this growth pattern is expected to continue through 1956.

Ever since 1949, when acetate first went after the lush ophthalmic market in earnest, sales have been on the upswing. By 1953, it was reported that acetate sheet stock, as used by over 25 leading manufacturers of spectacle frames, accounted for 5% of the over-all market. Since then, growth has been phenomenal. Today, with sales of all types of frames at a record high (about 20 million frames were sold in 1955 and over 90% of these made use of plastics), about 35 manufacturers are using extruded acetate sheet and the material now accounts for close to 20% of the total opthalmic market for plastics. Some of the more optimistic reports anticipate a 30% share within the next two to three years. At any rate, it is apparent that acetate is beginning to take a place alongside cellulose nitrate as a volume leader.

Advantages of extruded acetate

The reasons behind the growth in application of extruded acetate optical sheet are many.

For one thing, Celanese Corp. of America, the major supplier of optical stock, has developed a new form of extruded acetate sheet that has excellent dimensional stability and is specifically designed to meet the requirements for high-quality ophthalmic frames. No solvent is used in producing the material, thereby insuring an extruded sheet that is free of objectionable shrinkage and warpage resulting from loss of retained solvent. Non-flammable Lumarith acetate has also been formulated for maximum color stability. Crystal acetate frames are less apt to yellow and colored acetate frames are less apt to fade with age. By wheel polishing, by solvent dipping, or by tumbling first with a very fine abrasive burnishing compound and then with a polishing compound, the acetate frames can be given an unusually high lustrous finish.

Sophisticated acetate spectacle frames (by Victory Optical Mfg. Co.) complement evening dress. Step-by-step processes in fabricating frames from sheet are shown on following pages

Fig. 1: Thickness of sheet as it emerges from die is checked by beta ray gage (upper right) and hand micrometer. (All photos, Celanese)

Fig. 2: At Victory Optical plant, acetate sheet is cut into strips, preheated in oven (right), and fed into press which stamps out frame fronts and temples

Fig. 3: Grooves for insertion of lenses are cut into inside of frame front. Front is simultaneously beveled at the edges

According to those manufacturers who specialize in plastics ophthalmic frames, the working qualities of acetate are comparable to those of cellulose nitrate. As illustrated in Figs. 1 through 9, frames can be easily fabricated of acetate sheet using conventional techniques. Cutting, sawing, blanking, routing, shaping, polishing, heat-forming, and cementing can be accomplished on standard equipment and by regular trade operating procedures. To assure frames of maximum strength and freedom from stresses, blanking and heat-forming operations are best performed on heat-softened acetate. Wire-cored temple pieces are made either by bonding the wire between two grooved pieces of acetate or by injecting the wire into a strip of heat-softened temple stock.

After the acetate frames have been fabricated, prescription lenses can rapidly be inserted by heating the front of the frame, snapping the lenses in place, and immediately plunging the frames into ice water. The frames can be heated for this operation by burying the front part of the frame for 30 sec. in a "hot salt box" controlled at 250° F. or by using infra-red lamps or electric heaters. The entire lens-inserting operation should take 3 min. per frame.

Low cost of extruded sheet

Because of the ease with which acetate can be extruded ready for use and because of the low specific gravity of the material, acetate frames are lower in cost than those based on nitrate. Both Celanese Corp. of America and Nixon Nitration Works, Nixon, N. J., which recently entered the market as a supplier of acetate optical stock, make the sheet in thicknesses of from 0.020 to 0.255 in. in crystal; in transparent, translucent, and opaque colors; in pearl; in shell patterns; and in various other types of special effects—all of which are de-

Fig. 4: Preheated center portion of front is bent to shape on block; frame front is then submerged in cold water to set

Fig. 5: Frames are trimmed by a conical cutter which smooths the junction where nose pad has been cemented to the front

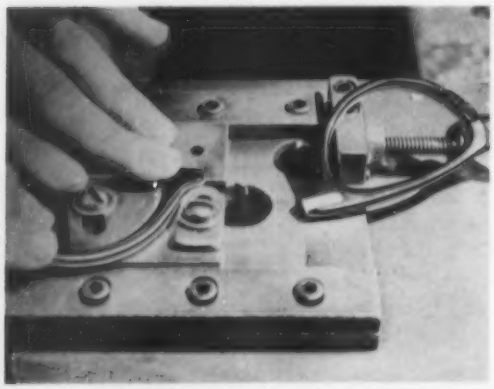


Fig. 6: Channel is cut into extreme ends of frame front to allow insertion of optical hinge. Temple is similarly slotted

liverable within four to six weeks from date of order.

In contrast, the "block" method by which nitrate sheets are made requires a manufacturing cycle of from 2 to 4 months (in some cases, cycles of as long as 6 months are necessary). The seasoning period alone which is required to remove remaining solvents after the nitrate has been pressed into cake form usually takes about 4 to 8 weeks.

For the manufacturer making use of extruded acetate sheet, this step-up in delivery date minimizes his problems of long range anticipation of stock needs and greatly simplifies inventory management.

More important, particularly in view of the major emphasis being placed today on spectacle frames as a style accessory, is the ease with which a manufacturer can test consumer reaction to the design of a new acetate frame without too great a financial risk. A minimum order of acetate sheet in a particular pattern or color is simply fabricated into the required number of test frames. If the style is accepted, the manufacturer is assured of delivery on a larger order of sheet for full-scale production within the six-week period; if the style falls flat, the manufacturer is not faced with the problem of having over-stocked himself in a useless pattern or decorative effect that will have to be dumped on the market or written off as a financial loss.

Decorative acetate frames

The emergence of spectacle frames as fashion accessories has drawn particular attention to the decorative possibilities inherent in plastics sheeting. Although corrective glasses were once looked upon as "optical crutches" that one was just forced to live with, they have now become high-style products that are sold on the basis of beauty and individuality. Today, corrective glasses are available in styles especially developed to meet the different dictates of various social, business, or recreational activities. As a result, multiple sales of spectacle frames to a single user have been on the upswing—and this concept of merchandising has been largely responsible for the large volume increase in the market for spectacle frames.

Nitrate and acetate in "block" form have long proved especially adaptable to the creation of the multi-color effects required for this type of high styling. By a continuous process of sheeting off the blocks, combining the sheets into new patterns, re-pressing the sheets into

block form, and sheeting the block off again, innumerable color combinations and novelty effects are possible.

To compete with these materials in the creation of such effects, Celanese has developed a number of decorating techniques that can be used with extruded acetate sheeting. By laminating a number of sheets of different translucent or opaque colors together, for example, a wide range of effects can be achieved. Where a sheet in one color is used as the base and a sheet in another opaque color as the overlay, it is possible to mill off the bottom half of the overlay to effect an attractive two-tone appearance. In another popular laminate, thin-gage acetate sheet with a pearl pattern is used as the overlay sheet and a heavier-gage clear acetate sheet as the base material. Some of the multiple laminations can include up to five 0.040 in. thick sheets in a variety of contrasting colors.

Celanese and Nixon have done work on laminating cloth, metallic sparkles, and other decorative fillers between layers of clear or translucent color sheets and special laminating techniques have also been developed to provide a variety of patterns in extruded pearlescent and metallic acetate sheets.

To match the variegated effects which have proved so popular in nitrate frames, double-stage extrusion is used to some extent. Acetate frames in rippled and variegated effects are also produced by laminating of a sheet of clear acetate over a base sheet on which the desired pattern has been applied.

In the majority of cases, however, both Nixon and Celanese match nitrate patterns in acetate by combining a "block" acetate overlay and an extruded acetate base sheet. The thin-gage overlay, usually in a rippled or variegated pattern, is produced in conventional fashion by sheeting off an acetate block. It is then laminated to the heavier-gage, less expensive extruded sheet. Nixon is also a leading supplier of nitrate sheet made by the block method.

To complement high styling in acetate frames, another popular technique being used by manufacturers is to trim the frames with ornamental hand-engraved anodized aluminum and/or gold-filled plaques.

By thus offering decorative possibilities that harmonize with current fashion modes and by providing the functional and economic advantages inherent in the use of extruded sheet, the acetate frame has become an important new factor in the ophthalmic industry.

Fig. 7: In final assembly step at Victory, temple and front are attached by screw inserted through channels in each piece

Fig. 8: After assembly, the acetate frames are wheel polished in order to achieve a highly lustrous surface finish

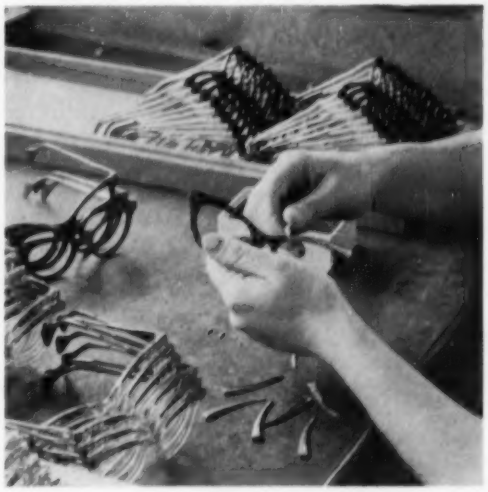


Fig. 9: As an added decorative effect, an aluminum plaque is fastened to the front top half of the finished frames

Subway ad with man "in motion" catches passenger's eye. Effect is achieved with butyrate sheet. (Photo, Pictorial Productions)

Illusion of motion in plastics

Going one step beyond the concept of three-dimensional displays, plastics sheet materials are now being used in the creation of animated signs and displays that offer, in addition to depth, a remarkably realistic illusion of motion.

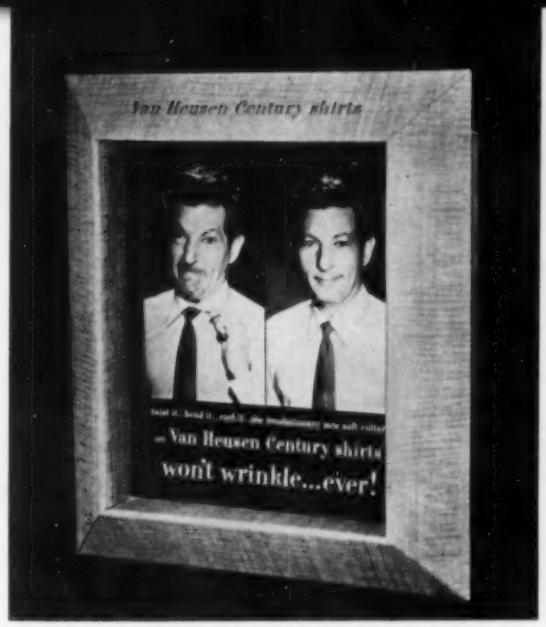
Most recent of the developments along this line are the fascinating new Vari-Vue plastic displays designed and manufactured by Pictorial Productions, Inc., Tuckahoe, N. Y. The displays require no mechanical devices or illumination to create the illusion of movement. Instead, animation is effected by the viewer's motion relative to the display.

To produce a Vari-Vue display, hundreds of tiny, parallel lenticulars, or lenses, are first pressed into the face of a transparent sheet of butyrate 0.045 in. thick. Using pressure and a special adhesive, the sheet is then laminated to a paper backing on which two or more art layouts or photographs, showing the subject of the display in various positions, have been photographically superimposed. The lenses are so designed that only one of the "scrambled" images beneath the clear sheet will be brought into focus within each viewing angle, while the others are effectively blocked out. Thus, as a person moves from one angle to the next or tilts the Vari-Vue picture back and forth, one image after another is presented to the eye in rapid succession. The resultant optical effect is that of a picture in which selected objects move.

When incorporated as an integral part of a finished display, Vari-Vue pictures provide a variety of startling and dramatic effects, ranging from simple changes in facial expression to the more complicated movements of the human body. Outside of the display field, the durability of the semi-rigid butyrate sheet, its dimensional stability, and the ease with which it can be precision die-cut in an infinite variety of interesting shapes have promoted the use of Vari-Vue for the manufacture of intriguing calling cards, badges, shelf markers, premiums, and direct mail gimmicks. Newest area of application for Vari-Vue is in the design of subway car cards; the weather resistance of butyrate sheet has stimulated investigation into the possibilities of Vari-Vue for outdoor billboard use.

Vacuum formed vinyl sheet

Another type of animated display, by Tele-Rama, Inc., New York, N. Y., is based on a vinyl color transparency. To create animation, the transparency is first vacuum formed in a simple contoured shape (generally hemispherical) in those areas where motion is desired. A second sheet of translucent vinyl, which



Depressed areas in vacuum formed vinyl transparency refract light from rotating bulb in box to produce "moving" display of non-wrinkle collar. (Photo, Tele-Rama, Inc.)

serves as a projection screen, is then placed over the flat surface of the formed transparency (the depressed areas face to the rear) and the two sheets are inserted into the front of a display light box equipped with a rotating bulb. When the light from this bulb passes through the depressed areas and is refracted in varying degrees by the changing contours, the subject represented in that particular area of the transparency shifts in position as it is projected on the vinyl outer screen—thereby giving the illusion of life-like motion.

Credits: Butyrate for Vari-Vue supplied by Eastman Chemical Products, Inc.; vinyl sheet for Tele-Rama supplied by Bakelite Co. and formed by Hernand Mfg. Co., Inc., Yonkers, N. Y.

Two sales messages of attention-getting value are combined in single sign, thanks to specially processed butyrate sheet

Not magic but butyrate sheet makes friendly face in counter coin receptacle wink at customer. (Photos, Pictorial Productions)

Service life of attractive two-tone canister set (by Federal Tool) is considerably increased by molding the rugged containers and covers of impact styrene. (Photos, Koppers)

High-impact styrene step-on can (by Columbus) has easy-to-clean polyethylene inner liner.

Flexible polyethylene decanter (by C. B. Cotton) has molded-in depressions for easier handling

Better plastics housewares

Winners of Koppers' design competition confirm trend towards top-quality styrene, and polyethylene housewares

Indicative of the advances being made by the plastics industry in upgrading housewares was the general high level of quality exhibited in the 214 entries submitted by 72 molders of plastics housewares to the second annual design competition sponsored by Koppers Co., Inc. From the wide diversity of products included among these entries, awards were made in each of four separate classifications to those articles judged best from the standpoint of design, quality, and imagination displayed.

Top award in the classification covering styrene products to be used with food went to a two-color, four-piece canister set molded of high-impact styrene by Federal Tool Corp., Chicago, Ill. Honorable mention in this classification was awarded to William E. Clements Design Associates, Inc., Cincinnati, Ohio, for a portable bar molded of regular styrene.

In a new category, polyethylene housewares used with food, the first prize (*To page* 235)

Self-watering planter (by Bu-Gay), molded in two pieces of regular styrene, combines beauty, utility

Market view of vinyl foam

Improvements in density control, a trend towards lower material costs, new fabrication techniques, all combine to help open new fields of application

The plastics industry's statistics for 1955 (see MODERN PLASTICS 33, 93, Jan. 56) show that vinyl resin sales last year reached 500 million lb.—a gain of 25% over the preceding year. That gain compared with 11% in 1954, 6% in 1933, and 5% in 1952.

In the breakdown of the 500 million-lb. figure into end-use categories was a "miscellaneous" grouping that accounted for some 46 million lb. of resin. It was here that foamed vinyl, representing a volume of approximately 4,600,000 lb., was included.

When the 1956 results are in, predictions are that foamed vinyl will have a statistic of its own, and a big one, because it is probably the fastest growing application for vinyl resins today.

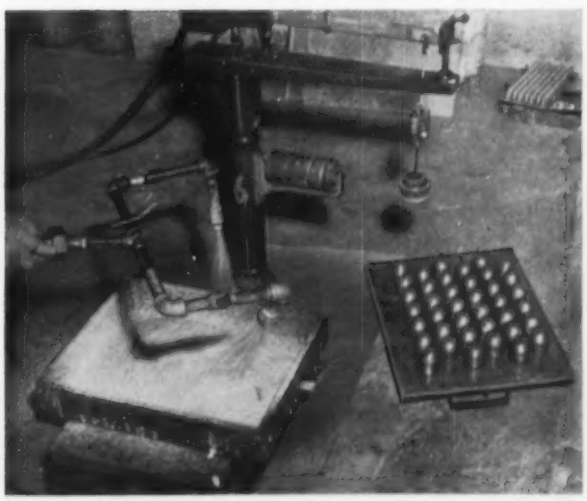
Production capacity up

The 1955 production capacity for polyvinyl chloride and its copolymers was in excess of 600 million lb.; further expansion is expected to bring the 1956 capacity to 725 million. Although not all the types of polyvinyl chloride included in these figures are equally satisfactory for foaming purposes, enough of the proper types are available to support a foam industry of over 75 million pounds. The enormous productive capacity plus the recently lowered price structure (see Chart I) plus research improvement of foam quality (see Charts II and III) plus field results from quantity applications could make foamed vinyl the fastest growing segment of the entire plastics industry in 1956.

Facilities now in operation can produce foamed vinyl at a rate of 500,000 lb. per month. Sales objectives for 1960 are aimed at 12.5 million lb. per month.

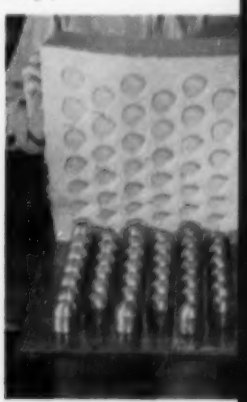
Cushioning applications

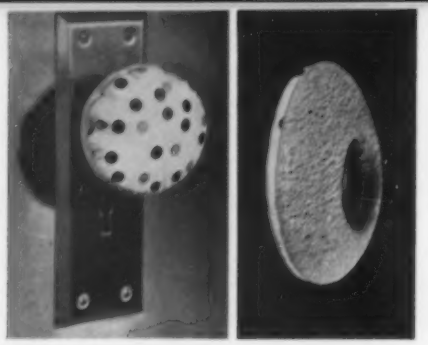
There is no doubt that cushioning is the basic market for the inter-connecting, open-cell type of foam, and there is no doubt either that the whole cushioning industry is rapidly changing from handcraft to machine. Cush-



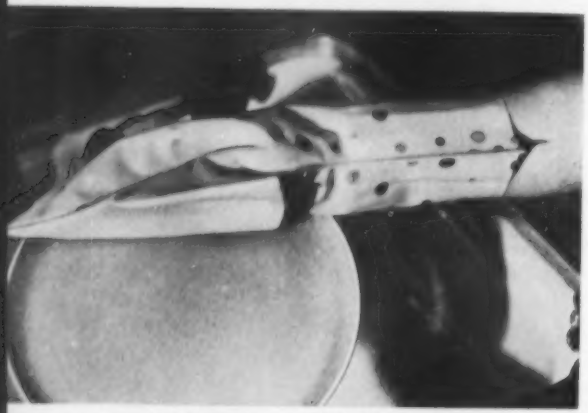
Production of molded cushions begins with spraying of vinyl foam into open aluminum mold; a double nozzle is used.

Cover plate with coring plugs is then positioned over filled mold. After foam has been fused at 350° F., the finished cushion is stripped off. (Photos, Elastomer Chemical Corp.)





Decorative cover stretches to fit over door knob (left), has foam backing (right) sealed to vinyl film



Dishwashing mitt has soap compartment between foam and vinyl film; two layers of film protect the hand. (Photos, Bolta Products)

Clothes "brush" is made by electronically sealing vinyl film to foam, using a tear-seal die

Bath sponge with pocket for soap chips and scraps is fabricated entirely of sheet foam by heat sealing.

Washable, long-lasting bathroom mat is made up of vacuum formed vinyl electronically sealed to foam backing. (Photo, Androl Industries)

ioning is no longer a laborious process involving the hand assembly of wire, padding, toppers, muslin, and ticking. Modern cushioning pours out of a nozzle and is fused into a mold (photo, p. 113).

Essential to the growth of foamed vinyl in the cushioning field is the proper selection of formulations and structures. For example, the stress-strain characteristics of foam must be studied to determine the proper formulations for an automobile crash pad as opposed to a seat cushion; both formulations could have equal density and hardness but will differ substantially in "feel," energy absorption, and compression resistance or cushioning value. Within the past year improvements in processing have made possible exact specification of formulations. Foamed vinyl can now be produced in a variety of densities from 3½ to 7 lb./cu. ft. in continuous as well as intermittent operation. Elasticity and resiliency can be controlled in the formulation; texture, cell structure, and cushioning properties are today predictable and reliable.

In addition to the basic assets of being resilient and flexible, foamed vinyl resists flame, aging, moisture, tearing, abrasion, acids, alkalies, and most chemicals. It is non-toxic. It is available in pure white or any color. It has 100% dimensional stability (no shrinkage). It is stable in the presence of moisture and is mildew resistant. "Breathing" is made possible by interconnecting cells. It heat-seals quickly and permanently and it can be embossed, die cut, split, or skived. It can be directly cast in continuous sheets onto textiles, most synthetics, and vinyl sheeting or film. Unlike other foams, exposure to air does not result in deterioration caused by either oxidation or hydrolysis.

Indeed, about the only shortcomings of foamed vinyl today as a cushioning material are its temperature sensitivity, its temporary set or "memory," and its permanent set (re-

lating to its ability to regain shape after subjection to a sustained load); the last, while good and improving, is not as good as that of properly foamed rubber. Unlike other foams, however, the load-carrying capacity of vinyl foam can be varied independently of its density.

Flat sheet or slab stock

Foamed vinyl for cushioning applications is recommended for use in three general forms: 1) sheet or slab stock in continuous lengths or rolls; 2) molded cushions, cored or otherwise, with or without surface contour; and 3) direct application during the curing process to carpeting, textiles, vinyl film, and other materials.

Flat stock in the form of plain slabs or sheets can be produced with varying thickness and width on a continuous conveyor system, or in the form of direct coatings. In the latter case, foam coated directly onto other materials is not supplied as a "stock" item and can be made available only on a customer order for large volume. For small orders, it is recommended that users laminate thin sheets of finished foam to surface materials, using bonding or heat-sealing techniques.

Most slab stock today is made several inches thick and cut off in lengths of from 5 to 20 ft., after which it is split to the various desired thicknesses. More recently, at least one producer supplies the foam in continuous rolls up to 100 ft. in length and anywhere from $\frac{1}{16}$ to 1 in. in thickness.

Many economies to the end-product fabricator are made possible when the foam is furnished in such long rolls. It is also possible to apply the foam continuously in thicknesses of $\frac{1}{32}$ to $\frac{1}{2}$ in. directly to various top surface materials. Such surface materials take the place on the conveyor of the usual movable belt from which the foam, when made in sheet form, is stripped.

Another approach to the job of applying the foam as a direct coating on surface materials is illustrated by a technique used for rug underlay. Foam coating is sprayed in the required thickness directly onto the back of the rug material. In such cases, some of the sizing materials, which normally must be used on rug backings can be eliminated, as the foam itself which is deposited in a wet state tends to lock the fibers in position.

Since the foam can be sewn, applications in which it is adhered to textiles are expected

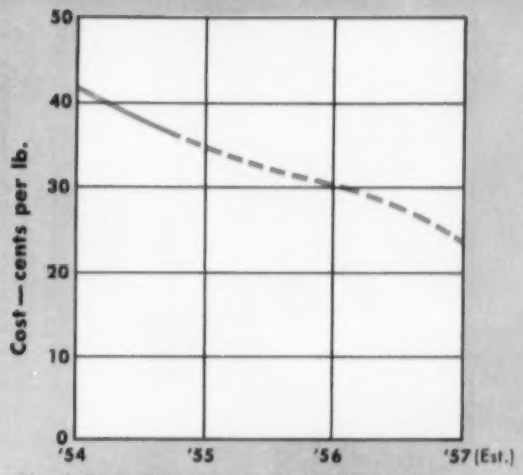


Chart I: Declining cost of plastisol grade vinyl resin. (broken line = estimates)

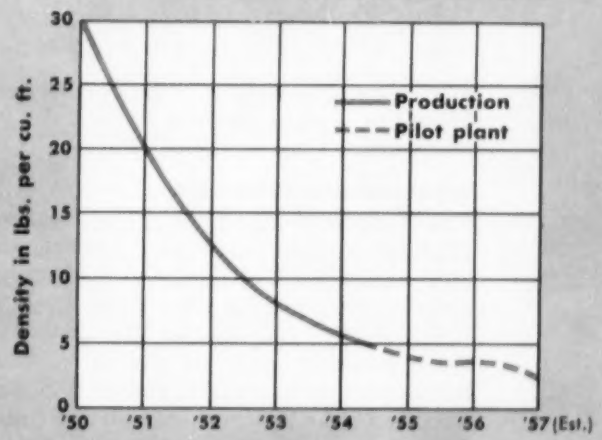


Chart II: Reductions noted in foam density as a result of improved processing methods

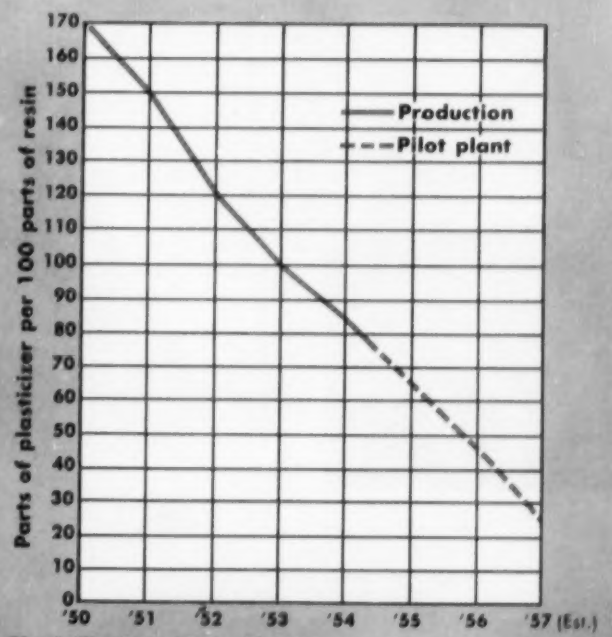
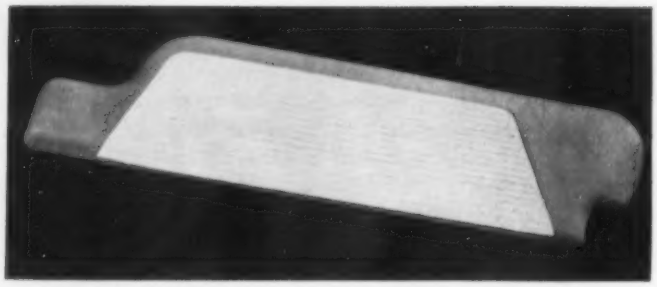


Chart III: Lowered plasticizer concentration derives from improved resin formulation

Charts courtesy Elastomer Chemical Corp.



Padded automobile sun visor is produced by molding foam padding around visor insert and then heat-sealing vinyl film around the foam assembly with a tear-seal die

School seat with vinyl foam pad incorporating a slush-molded integral skin was developed for American Seating Co. (Photo, Brown Rubber Co.)

to increase. Flat slabs may also be heat embossed to produce various surface designs, ornamentation, and special effects.

Applications for sheet stock

In sheet form vinyl foam is being used for furniture padding, seat toppers for railroad cars, arms of chairs and sofas, and for padding for the springs of upholstered furniture. It is presently being used as filter gaskets for air conditioning units. In juvenile goods, it has obvious applications to stuffed toys, bath toys, high-chair seat pads, and play-pen pads. It produces no toxic effects through respiration, mastication, ingestion, or contact with the skin.

Padded upholstery panels for vehicles are becoming a major safety factor.

For footwear, foam is used for insoles and linings. Combined with vinyl, interesting embossed effects can be achieved by electronic heat sealing.

In sportswear, foamed vinyl has wide utility as padding and protection. As the lining in a completely heat-sealed skate strap it has proved an improvement over previous constructions.

In other clothing applications, flat stock foam lends itself well to the new principle of layering in order to achieve better resistance to wind and cold. Experiments during the war with troops stationed in extremely cold climates proved that light materials with inner lining provided greater protection than a heavier material unlined.

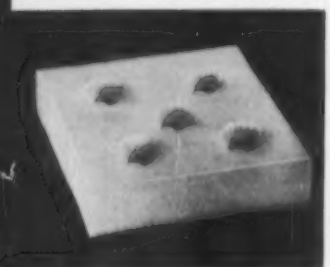
It is being employed as shoulder pads and as inserts in bras. It can be used to provide extra padding and perspiration absorption under the sweat bands of hats, as well as to give thickness and softness to cap visors.

Foamed vinyl possesses far-reaching possibilities for such fashion accessories as gloves, handbags, and belts. (See "Success in Accessories," MODERN PLASTICS, *33*, 99 (April 1956.)

Mattress pads ¼ to 1 in. thick for the sickroom can help to avoid or to clear up bed sores. The foam is aerated as the body moves and perspiration is absorbed.

Provided with a flexible or rigid handle, preferably heat-sealed with a tear-seal, the foam makes a good clothes brush (photo, p. 114). A wide variety of other (*To page* 227)

Heat sealing is used to create button pattern in flat sheet stock. (Photo, A. W. Peterson & Sons Die Co.)



Vinyl-coated fabric is sealed around foamed vinyl padding to produce resilient church seating. (Photo, L. E. Carpenter Co.)

Film editor housed in phenolic

In an outstanding application of plastics in photographic equipment, The Kalart Co., Inc., Plainville, Conn., has housed its editor-viewer EV-8 in molded phenolic. The EV-8 makes it possible to view 8-mm. motion picture film 12 times enlarged without need for setting up projector and screen, and to edit, cut, and splice the film with a minimum of trouble.

By choosing phenolic, Kalart provided the amateur home movie maker with a product that is simple to operate, pleasing to the eye, comparatively inexpensive, sturdy, and foolproof in operation.

The complete plastic viewer housing consists of three parts: light housing, screen housing, and splicer base. All are compression molded of wood flour-filled phenolic. Since the three parts are combined into an integrated unit, it was necessary to maintain an even and critical balance of temperature and pressure during the molding cycle to achieve color uniformity.

The lamp housing incorporates a series of molded-in louvers for dissipating heat, and a series of molded-in horizontal ribs for rigidity and decorative value. When the part is removed from the mold, the flash around the edges is filed off and cross holes for the light path are drilled; flash at the louvers is removed with Wheelabrator equipment.

The screen housing has a molded-in opening to which a ground glass-type screen is attached. The ribbed construction is repeated on the front of this part to provide a unified decorative element. The splicer base is molded as a separate unit.

Assembling the editor-viewer

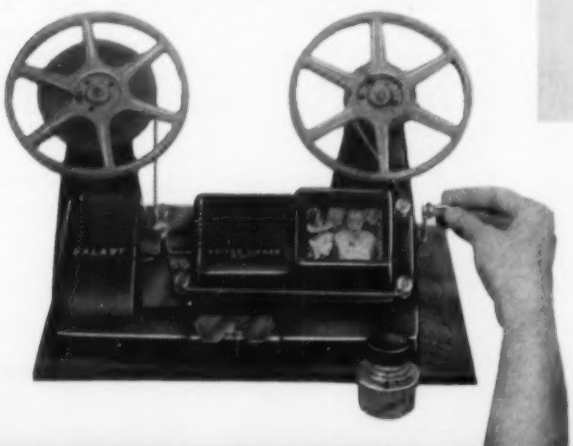
The phenolic parts have all necessary openings, bosses, and threaded inserts molded-in. No finishing operations (aside from deflashing), are required. They are screw-fastened to a steel plate base shaped to the exact contours of the housing.

The editor-viewer assembly is then mounted to a hardwood platform. An elevating locking hinge keeps the viewer upright when in use and permits it to be returned to a horizontal position for convenient storage.

Credit: Kalart EV-8 molded by General Electric Co.'s Plastics Dept., using G. E.'s 12885 general-purpose brown phenolic.

Three sturdy molded phenolic components (foreground) are assembled into handsome housing for home movie accessory. (Photos, G-E)

Phenolic-housed movie editor-viewer is characterized by simplicity of operation. Bottle (foreground) contains splicing cement



Reinforced plastics oar has rod compartment

Lightweight oars designed to give "lifetime" service without need for any maintenance are molded of reinforced plastics and offer additional advantages of high strength, durability, and resistance to warping, splitting, and breaking. Each oar has a removable, watertight handle molded of phenolic which unscrews to give access to a fully protected compartment for storage of fishing rods, extra lures, etc.

The oars are molded in one piece and are produced in matched metal molds. The handles are compression molded as is also a threaded phenolic collar which is cemented to the inside of the hollow end of the oar. The oar tip is strengthened by increasing the thickness of the blade section at that end; this also adds balance for better rowing.

Credits: Glasrin oar is manufactured by Plastic Age Reinforced Products Inc. and distributed by Plastic Age Sales Inc., San Fernando, Calif.

PLASTICS

Acrylic faces for cigarette lighter

To provide an unusually attractive appearance and adequate protection for the decorative illustrations on Ronson's "Trophy" cigarette lighters, the bodies are covered with clear, transparent faces of injection molded acrylic.

The acrylic parts, produced in a 2-cavity mold at 24 shots per hr., are 3 9/16 in. long and 1 3/8 in. wide. Maximum thickness of the sides, which, in cross-section, are flat on the inside but crowned on the outside, is 3/8 inch. To assemble, the paper which bears the illustration is first affixed to the metal body of the lighter with pressure-sensitive tape. Then tongue-and-groove members at the ends of the acrylic pieces are wetted with a solvent cement applied with a hypodermic, and the pieces are clamped around the body until the welds are complete.

Credits: Molded by Boonton Molding Co., Boonton, N.J.; Plexiglas supplied by Rohm & Haas Co., Phila., Pa.

Broom hanger molded of butyrate

Neat, convenient storage for mops and brooms is provided by a new hanger which consists of three separate molded butyrate rings which are hinged to a butyrate wall bracket. The rings, lined with rubber to insure a firm grip, hold broom and mop handles in vertical position and keep them from falling, slipping, or sliding. A broom or mop is easily slipped out for use simply by lifting the ring slightly; when not in use, the rings fold back parallel with the wall. The sturdy, attractive hanger is available in four colors—yellow, red, green, and blue. Since the colors are molded-in, they cannot chip. The hanger comes complete with screws for easy mounting on wood or plastered walls.

Credits: BroomMaster is manufactured by Woodmaster Co., Osseo, Minn.; molding by Booker and Wallestad, Inc., Minneapolis, Minn.; Tenite butyrate supplied by Eastman Chemical Products, Inc., Kingsport, Tenn.

PRODUCTS

Table accessories molded of melamine

Colorful and convenient table accessories, which include a single-tiered Lazy Susan (at left) and twin-level snack and candy serving bars, are being molded of heat-resistant melamine. The handsomely styled accessories are available in a wide range of colors, including crisp green, sunset red, shell white, and ebony black.

The twin-level snack bars are offered with a 10-in. bowl top and either a 12-in. bowl or 14-in. platter bottom. The candy bar has a 6-in. plate top and a 7¼-in. plate bottom. A 14-in. patio platter, 12-in. salad bowl, bread and butter plates, vegetable and individual serving bowls, and a fruit dish, all molded of melamine, are also available.

The tableware is sturdy, durable, and virtually unbreakable, and will remain bright and attractive despite repeated washing in hot, soapy water.

Credits: Mission Tableware is manufactured by Koch Mfg. Co., St. Louis, Mo.; Plaskon melamine supplied by Barrett Div., Allied Chemical & Dye Corp.

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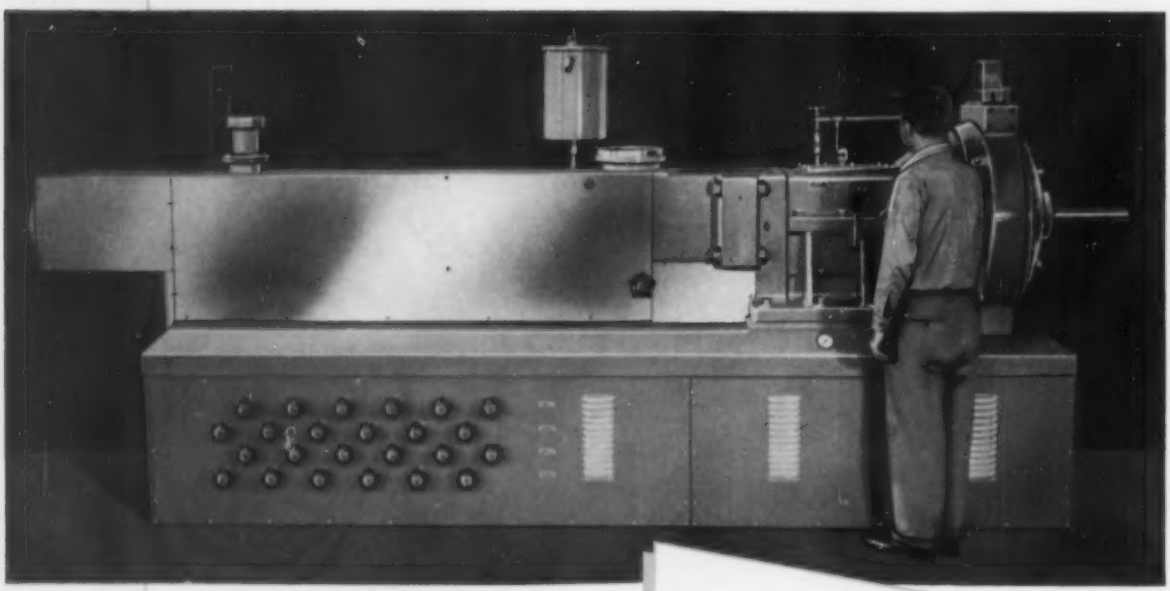

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Plastics Engineering

Dr. James F. Carley, Engineering Editor

Choosing adhesives for plastics

By Irving Skeist†

Polymer crystallinity and solubility guide the selection of adhesives for bonding plastics to themselves and to other materials. Using the solubility parameters calculated by other investigators, it is possible to predict what solvents will make good bonding agents for any particular plastic system. To be strong under a variety of service conditions, bonds must be thin and about as stiff as the adherents. To give strong bonds, adhesives must have low viscosities when applied, very high viscosities when set. Such adhesives are polymer solutions and latices, or polymerizable mixtures.

The usual order of development in an expanding technology is characteristic also of the adhesive bonding of plastics: our know-*how* has grown faster than our know-*why*. In the early days of the industry, when cellulose nitrate was the chief plastic, it was feasible to learn by trial and error how to bond plastics to other plastics, to woods, etc.

Today we have a profusion of plastics, most of them more difficult to bond than cellulose nitrate. Pipe, vials, fabricated displays, complex toys, metallic yarn, films for packaging, vinyl-clad metal for luggage—for these and a myriad other products good adhesive bonds are essential. In this paper we present some of the latest know-why—a system, based on molecular structure, for choosing solvents, plasticizers and resins for adhesives used in bonding plastics.

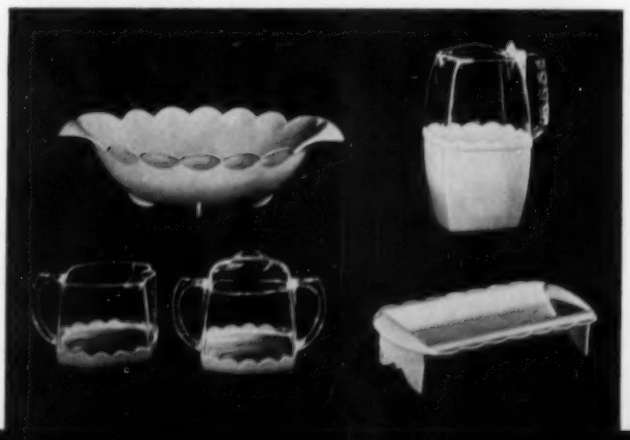
Recent research has made available two guideposts for choosing adhesives: crystallinity and polarity (as measured by solubility parameter). Consideration of these two important quantities has made it possible to produce attractive products like those in Figs. 1, 3 and 4 by adhesive bonding. It has also helped in the development of the following tentative set of rules.

1. The crystalline plastics are best bonded by heat rather than adhesives (i.e., best adhesive is polymer itself, melted).

2. Amorphous or non-crystalline plastics are bonded to themselves with monomers or solvent cements, sometimes resin-bodied.

3. To bond two different plastics, or a plastic to a non-plastic, it is best to use a polymeric adhesive. For good *ad*hesion to the two surfaces, the initial viscosity of the adhesive should be low, while for good cohesion within

Fig. 1: Table set pieces are made by cementing together separately molded Styron tops and bottoms. (Photo, Dow)



Based on a talk given at the Jan. meeting of the Newark Section, S.P.E.
*Reg. U. S. Pat. Off.
†See panel, p. 123.

the adhesive layer, its final viscosity must be high. The viscosity change is accomplished by evaporation of solvents from cements, evaporation of water from latices, polymerization of monomers, or curing of resin intermediates.

4. To minimize strains (and resulting stresses) caused by flexing or temperature change, the adhesive layer should be as thin as possible, and no more rigid than the materials being joined (adherends).

5. Solvents and polymers for adhesives should be selected to correspond to the adherends in solubility parameter. This may require the use of a two-layer adhesive if there is a big difference between the solubility parameters of the two adherends.

6. Low-boiling solvents give the fastest setting action, but are more likely to cause crazing. Crazing is most likely to occur with the more brittle plastics, and is minimized by avoiding low-boiling solvents, or by diluting them if they are used.

7. Plasticizer migration is sometimes a problem when two different plastics, at least one of which is plasticized, are brought together. Among the remedies are 1) use of non-migrating plasticizers, 2) harder formulation of the plasticized material, 3) use of plasticizers incompatible with the other plastic. The solubility parameter may aid in choosing plasticizers.

These are the rules as of today. Our first step in using them is to classify the plastic materials according to ease of solubility (or non-crystallinity) and type of solvent (or solubility parameter).

Crystallinity

In Fig. 2, below, the highly crystalline, difficult-to-dissolve plastics like 6/6 nylon, polyethylene and Teflon, are at the left, while the amorphous, easily dissolved plastics like polystyrene and polyvinyl butyral are on the right.

In a crystalline material the atoms are regularly spaced in a characteristically regular pattern called a lattice. Although polymer molecules are too long, too

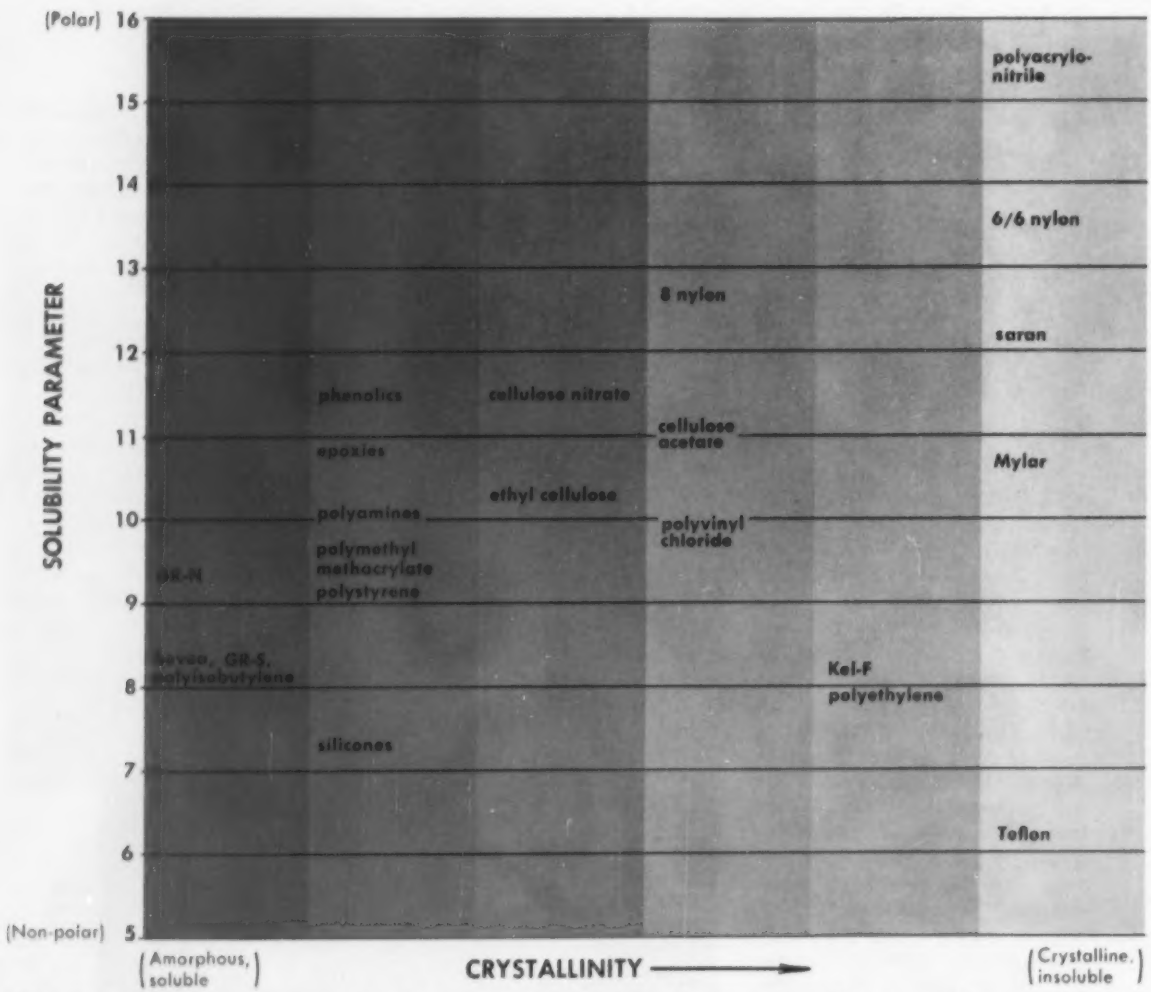


Fig. 2: Crystallinity-polarity map for the common polymers and elastomers. Crystallinity ranges from zero at the left to roughly 60 to 70% at the right. The more crystalline polymers are harder to dissolve, some only dissolving in hot solvents. Solubility parameter is a guide to choosing an effective solvent.

The author

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variable in size, and too complex to fit into a pattern that is 100% crystalline, many of them do have crystalline regions of high density that are not easily penetrated by solvents.

Since crystallinity is a matter of fitting together, the most crystalline plastics are those made of uniform symmetrical molecules with few side chains, for example 6/6 nylon (polyhexamethylene adipamide), saran (polyvinylidene chloride), Mylar (polyethylene terephthalate), and Teflon (polytetrafluoroethylene). The Ziegler and Phillips "low-pressure," semi-rigid polyethylenes are more crystalline than the current, more flexible polyethylenes because they have fewer disruptive side chains. No information has yet been published on the adhesive bonding or printing of these new materials, but one may expect that they will be even more troublesome than our present polyethylenes.

Copolymers, built from two or more monomers, are less crystalline and hence more readily soluble than homopolymers. Whereas the chain links of a homopolymer might be compared in regularity of line-up to Radio City's Rockettes, the multi-sized links of copolymers are more comparable to the chorus of an amateur theatrical troupe. An outstandingly soluble copolymer is Dynel, a fiber copolymerized from acrylonitrile and vinyl chloride. This polymer is spun into fiber from an acetone solution, yet neither polyvinyl chloride nor polyacrylonitrile is dissolved—or even swollen—by acetone!

The plasticized plastics—vinyls and cellulosics—span a wide range of crystallinity. Rigid PVC is fairly crystalline, but the alignments can be broken up by plasticizer, or by adding a small percentage of vinyl acetate to the monomer. In the cellulosics, the crystallinity seems to depend mostly on the hydroxyl groups. The ester groups hinder the hydroxyls on one molecule from coming in contact with other molecules. The butyrate radical is larger than acetate, consequently interferes more, and cellulose acetate-butyrate is therefore less crystalline and more easily dissolved.

In the nylons, crystallinity is reduced, and solubility improved, in either of two ways. Type 8 nylon contains an alkoxy side chain which keeps the molecules apart. Alternatively, the nylon copolymers are built from amines and acids of different lengths, interfering with regular alignment or "registration."

When heated above their melting points, the crystalline plastics lose their crystallinity and become soluble. Thus polyethylene can be dissolved in *hot* toluene. More commonly, polyethylene and other crystalline plastics are bonded to themselves or to nonplastics through heat alone. They melt more sharply than the amorphous plastics, and, over a small interval of temperature, may exhibit big drops in viscosity. In the molten, high-flow condition some of them are spray-coated onto metals; many, as pipe, are easily welded; and polyethylene film, hot from the extruder die, is easily melt-laminated to kraft paper.

Fig. 3: Authentic miniature Ford tractor is made of cemented acetate parts. (Photo, Celanese Corp.)

Special solvents are available for some of the highly crystalline materials. Dimethyl formamide dissolves polyacrylonitrile. Formic acid and phenol attack 6/6 nylon. Dacron, the terephthalate polyester in fiber form, is soluble in phenol and softened by benzyl alcohol, or by a 3:1 solution of phenyl methyl carbinol and acetophenone.

The Kreidl and Krichever heat-oxidation treatments get around the inertness of polyethylene by oxidizing it at the surface that is to be printed, coated, or bonded.

Du Pont's alkyl titanates, applied to inert plastics from organic solvents, hydrolyze to leave a microscopic film of titanium dioxide which effectively primes the plastic surface.

For Teflon, the ultimate in in-

Fig. 4: Styron tableware tumblers and salad server have double walls made by cementing together separate moldings to give trapped-air insulation between walls. (Photo, Dow Chemical Co.)

STOKES news and views

Flanged parts can now be molded automatically

New Stokes development incorporates use of split molds in automatic presses

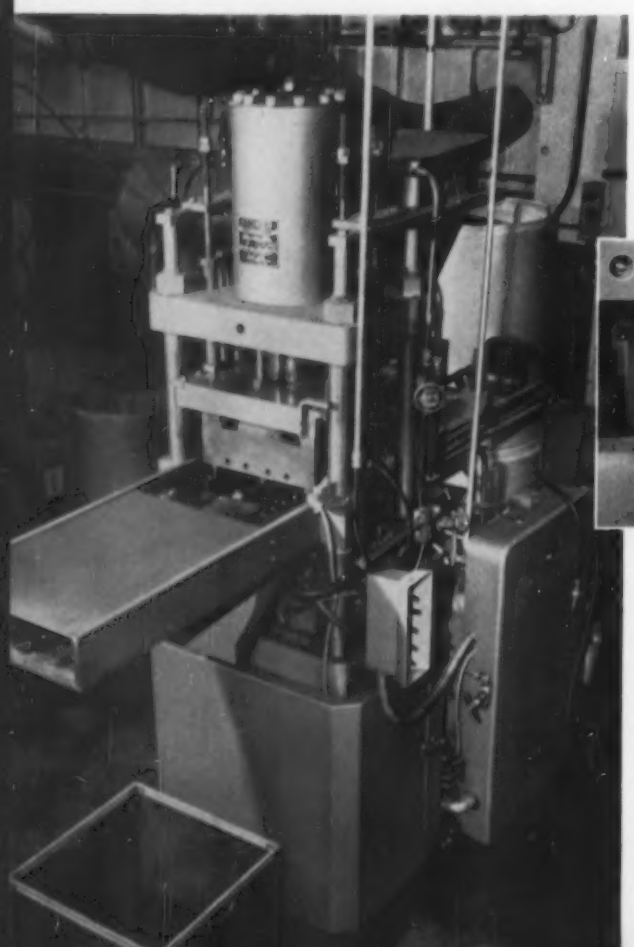
Thermosetting plastic parts requiring split molds have long defied automatic molding techniques. A new development by Stokes, however, brings the economies of automatic molding to this problem for the first time.

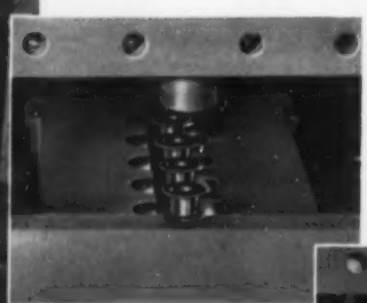
The secret is side-draw mold action, which Stokes engineers designed into a standard Model 741 fully automatic compression molding press. Because of the large platen area required for split molds (this is true whether it be a semi-automatic or automatic press), the Model 741 is restricted to a single line of cavities. However, because of the low labor cost inherent in fully automatic molding, cost per piece is reduced considerably as compared to semi-automatic operation.

Press action is as follows: the mold opens and the cavity blocks move upward and sideward, releasing the molded piece. At the same time, ejector pins advance the finished part clear of the mold. A comb then moves in, ejecting the parts, after which the mold blocks and ejector pins return to their original position.

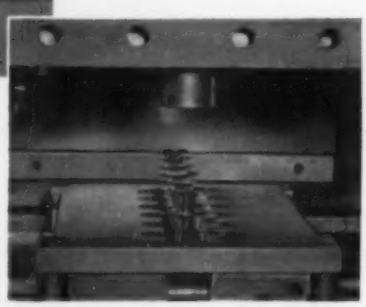
Features of the Stokes Model 741 press help to make this new technique possible and practical. The standard cylinder in the bottom of the press, unique in the field, supplies motive power to actuate the side-draw action. Additional hydraulic cylinders provide ejection and retraction motion for the core pins. Adjustable air blasts for cleaning flash from the mold, and new safety checks to protect the press sequence, are additional operating adaptations in the press.

Write to Stokes for information on how this molding idea can be applied profitably to your specific problem.





Mold opens; cavity blocks move apart.



Mold fully opened; coil forms raised on ejection pins.

Midwestern manufacturer of electronic equipment uses this Stokes Model 741 to mold coil forms—at labor cost of only a fraction of a man's time.

of plastics progress

This Stokes Model 800 Fully Automatic Compression Molding Press in the Toronto plant of Cords (Canada) Ltd. has produced 400,000 phenolic socket parts of superior quality in 800 hours' operation.

Fully automatic molding cuts socket parts cost 80%

Small mold and low labor cost keys to savings on 15 Ton Stokes Automatic

By using a Stokes Model 800 fully automatic molding press, part costs at Cords (Canada) Ltd. are one-fifth of what they were when produced on a semi-automatic press with a mold having four times as many cavities. In addition, product quality is superior.

The Model 800 operates with no labor or supervision other than removal of finished parts and loading of the hopper each morning, and at the end of the regular 8-hour shift. The press operates round-the-clock, including the hours through the night when no one is in the plant.

From the initial planning stage to start-up operation, Stokes men have contributed to the success of the installation. It's another good example of how the extensive experience Stokes has had in engineering, building and applying advanced methods of automatic molding can pay dividends. For facts useful in your consideration of automatic production, write for the booklet, "Fully Automatic Compression and Injection Molding."

Molders and custom finisher cooperate to produce quality parts at low cost

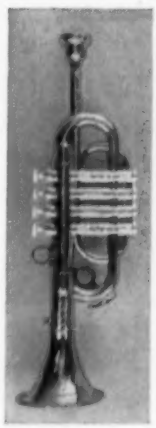
Teamwork needed to capitalize on vacuum metallizing process

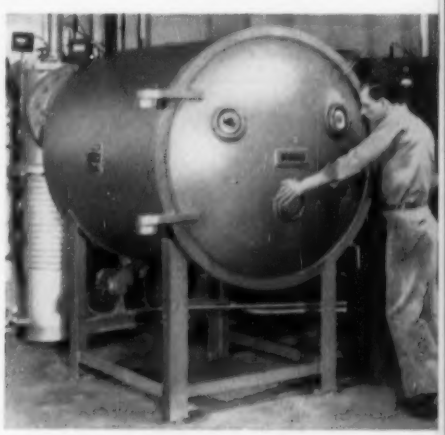
American Metalizing Corporation, New York City, has marked notable growth in its two-year history. And behind this success story is a business philosophy founded on mutual interest of the molder and metallizer.

Says Harry Saidel, American Metalizing president—"A plastics manufacturer should certainly get together with his finisher at the earliest stage possible. The molder will usually find it to his advantage to draw on this experience, and take account of our handling methods before he designs his molds."

By helping to keep customers' costs down, American Metalizing has built a substantial business. Their production—handled in two Stokes metallizing units—ranges from tiny items processed in batches of thousands at a time, to bright finished toys like the trumpet shown here. Included are lipstick cases, bantam flashlights, plastic toy cars and Christmas tree decorations.

The pair of 48-inch Stokes metallizers which the company now operates provides large capacity and ample versatility to accommodate varied production requirements.





(Right) One of the pair of Stokes 48-inch metallizers, at American Metalizing Corporation, Bronx, N. Y.

(Left) Gold-finished toy trumpet is typical of the toy and specialty plastic pieces economically processed at American Metalizing.

F. J. STOKES MACHINE COMPANY
5505 Tabor Road, Philadelphia 20, Pa.

STOKES

solubility by virtue of its high crystallinity and low solubility parameter, the manufacturer recommends drastic treatment as a preliminary to bonding: it is immersed in a solution of metallic sodium in liquid ammonia. This hazardous procedure is not to be attempted lightly.

Solubility parameter

If the plastic is sufficiently non-crystalline to dissolve, then the solubility parameter (SP) tells us which solvents to use. Reading downward in Fig. 2, the more polar plastics like nylon have high SPs, while the less polar hydrocarbon and fluorocarbon plastics have low SPs. Each plastic material dissolves best in solvents whose solubility parameters are about equal to its own. This is the modern technical version of the old cliché, "like dissolves like."

The solubility parameter is the square root of the cohesive energy density (CED), which measures the attraction of molecules for each other. Physically, the cohesive energy density is the amount of energy required to vaporize one cubic centimeter of a liquid:

$$(SP)^2 = CED = \frac{\Delta E}{V} = \frac{\Delta H - RT}{V}$$

$$= \frac{\rho}{M}(\Delta H - RT)$$

where ΔE = energy for vaporization, cal./mole; V = molar volume, c.c./mole; ΔH = latent heat of vaporization, cal./mole; R = gas constant = 1.987 cal./mole, °K.; ρ = density, g./cc.; M = gram-molecular weight, g./mole; T = absolute temperature, °K.

A non-polar molecule such as methane evaporates readily, and is a gas at ordinary temperatures. It has a low CED, hence a low SP (~6). By contrast, a highly polar, associated (hydrogen bonded) material of the same size, such as water, requires high heat input to evaporate it, consequently has a very high SP (23).

Hildebrand and Scott, Small, Burrell, and others have determined the SPs of a number of solvents and of plastics and resins. The polymers are graded according to these values in Fig. 2.

The solubility parameters help us understand why polystyrene (9.1) is soluble in butanone (9.3) but not acetone (10.0), while cellulose acetate (10.9) dissolves in ethyl acetate (9.1) but not butyl acetate (8.5).

An even more striking example of the usefulness of the SP is that it explains the fact that a plastic will sometimes dissolve in a mixture of two liquids, neither of which is itself a solvent. The classic example is the solubility of nitrocellulose (11) in the non-solvents alcohol (12.7) and ether (7.4). The mixture of non-solvents, one too high and the other too low, has its SP within the right range.

Similarly, the solvent acetone (10.0) mixed with a small proportion of the non-solvent alcohol (12.7), is a better solvent for cellulose acetate (10.9) than acetone alone. Isopropyl alcohol (11.5) and toluene (8.9) combine to provide a superior solvent for ethyl cellulose (10.3).

Table I, below, lists the SPs for some of the more common solvents. There are many exceptions; but by matching this table against the chart, it is usually possible to select those solvents "most likely to succeed" for a particular plastic. From a study of the exceptions, it appears that the more polar plastics require more polar solvents.

In Table II, p. 127, SPs are presented for some of the plasticizers

Table I: Solubility parameters (SP) of solvents and resins (S=soluble)

Solvent	*Drying rate*	*SP of solvent*	*Polystyrene (SP=9.1)*	*Polymethyl methacrylate (SP=9.5)*	*Vinyl chloride polymers (SP=9.7)*	*Cellulose acetate (SP=10.9)*
ether	fast	7.4				
amyl benzene (1-phenylpentane)	slow	8½	S			
xylene	medium	8.8	S			
toluene	medium	8.9	S			
ethyl acetate	fast	9.1	S	S		S
ethyl methyl ketone (2-butanone)	fast	9.3	S	S	S	S
trichloroethylene (1,2,2-trichloroethene)	fast	9.3	S	S		
perchloroethylene (1,1,2,2-tetrachloroethene)	medium	9.4	S	S		
methyl acetate	fast	9.6				S
dichloromethane	fast	9.7	S	S		S
1,2-dichloroethane	fast	9.8		S		
dioxane	medium	9.8			S	
cyclohexanone	medium	9.9			S	S
cellosolve	medium	9.9				
acetone	fast	10.0				S
isopropyl alcohol	medium	11.5				
dimethylformamide	medium	12.1		S	S	S
nitromethane	fast	12.7				S
ethyl alcohol	fast	12.7				
water	medium	23.4				

commonly employed with cellulosics and vinyls. It is clear from the figures why tricresyl phosphate is preferred for vinyls and triphenyl phosphate for cellulose acetate. Turning to the phthalate plasticizers, we seem to find a discrepancy. Dioctyl phthalate is the preferred plasticizer for PVC, while the calculation suggests that dibutyl phthalate should have better solvent action. Actually, other factors besides solvating action must be considered; dibutyl phthalate would be too volatile at the high processing and use temperatures to which PVC plastics are subjected. Also, in plastisols and some other vinyl formulations, plasticizers appreciably lower than PVC resin in solubility parameter yield compositions of lower viscosity and longer shelf life. This confirms rather than contradicts the theory.

The epoxidation of butyl oleate converts it from a secondary (9.0) to a primary plasticizer (butyl epoxystearate, 9.7).

Incidentally, Fig. 2 points up the differences between fibers, plastics, and rubbers. The materials in the upper right portion, high in both crystallinity and solubility parameter, are the fiber-formers: nylon, saran, cellulose acetate, polyethylene terephthalate. In the lower left portion, amorphous and low in solubility parameter, are the elastomers: hevea (natural rubber), GR-S, GR-N, polyisobutylene. Plastics are in both corners and in between as well.

Glass-reinforced polyesters are a cured glass-resin system that present a special problem in adhesive bonding. Having been cured, they are not soluble. Here, the epoxy adhesives, which often contain no solvents at all, come into their own. Figure 5, right, shows a typical application.

Crazing

Even though our plastic is amorphous and we know the SP range, the choice of solvent poses a dilemma. The low-boiling solvents attack the plastic surfaces most quickly, permitting fastest assembly. But low-boilers also evaporate from the cemented piece most readily, leaving the joint in a state of stress which may be relieved by crazing.

Crazing, the formation of many tiny cracks, seems to be worst with those plastics having the lowest impact strength. As a measure of impact strength we use here the product of tensile strength and elongation at break; this product is an index of the energy needed to rupture a piece at relatively low impact velocities (see Table III, p. 130).

Except for rigid PVC, the order of T-E product is also the order of craze resistance, with polystyrene worst. PVC has better craze resistance than this figure indicates. Methylene chloride, highly volatile, softens polystyrene or acrylics quickly; but the polystyrene bond will craze in less than a month. Even without bonding, an injection-molded piece may be sufficiently strained at the surface to craze when exposed to too active a solvent. Annealing at slightly below the softening temperature is of some help with acrylics, less effective with polystyrene.

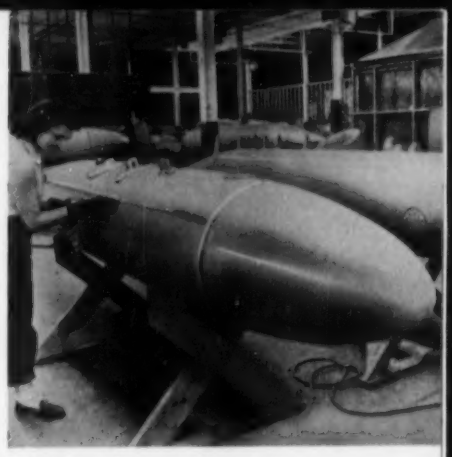


Fig. 5: Glass-reinforced polyester sections of airplane wing tank made by Admiral Corp. are cemented together with Epon VI epoxy-resin adhesive. (Photo, Shell Chemical)

High-boiling solvents and nonvolatile plasticizers, while slower to take hold, are safer. Perchloroethylene has been recommended for acrylics, amyl benzene for polystyrene. Methylene chloride is permissible for quick starting.

Many different "cements" are used in bonding plastics. A cement may contain some resin or it may simply be a mixture of solvents. In resin-bodied cements, a single solvent is almost never used. A mixture of low- and high-boiling cements is used to control the evaporation rate. If evaporation proceeds too quickly, crazing, blushing, and poor adhesion may result. If it proceeds too slowly the cement takes too long to set.

Bonding of dissimilar plastics

Adhesive bonding is often the only practical method of bonding dissimilar plastics. The bond is usually weaker than that obtainable by bonding two pieces of the same material.

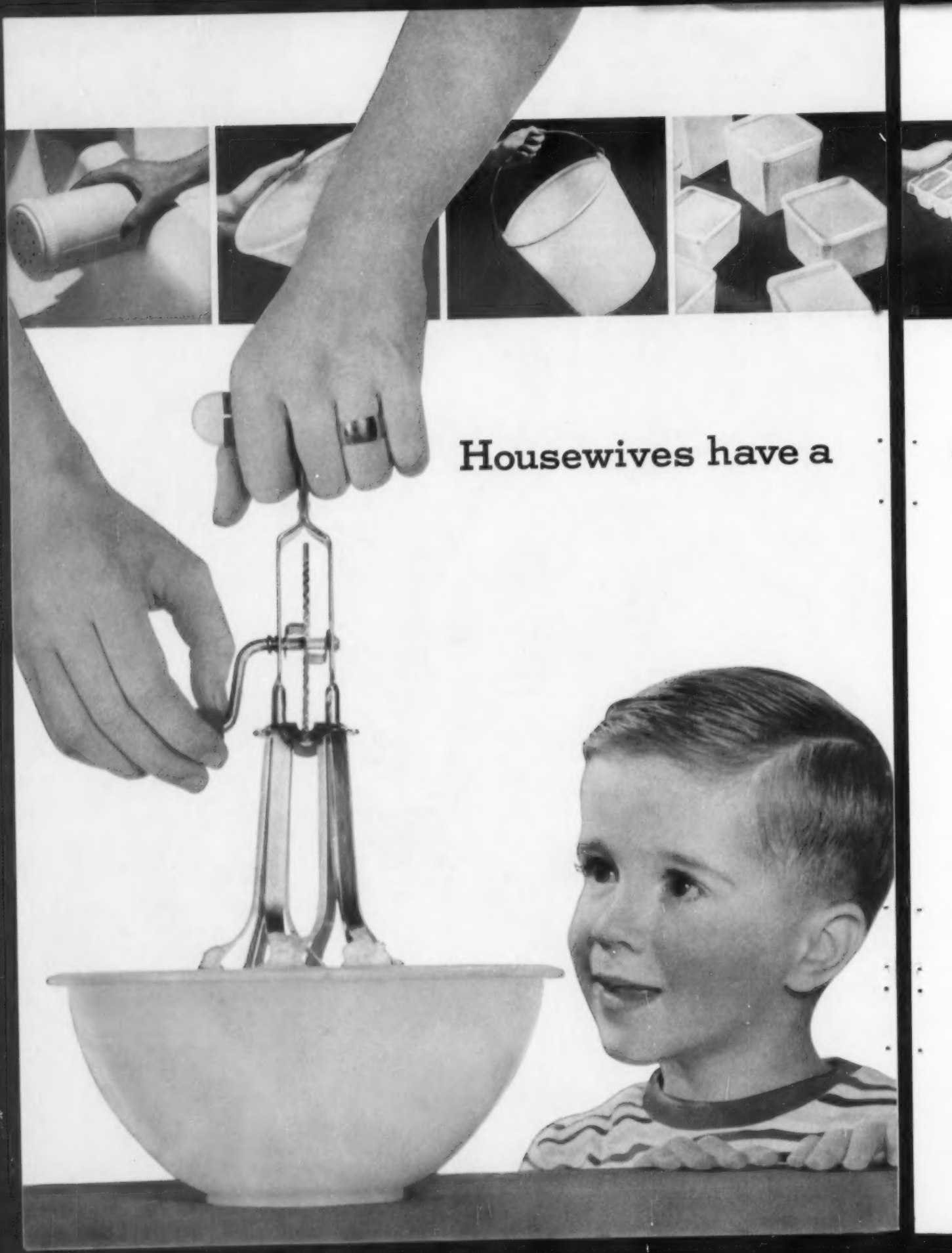
The individual differences among high polymers create difficulties. The vinyl compounder knows he can blend vinyl chloride resins with ethyl cellulose, acrylics, or butadiene-acrylonitrile rubber, all lying within the

(*To page* 130)

Table II: Calculated solubility parameters of plasticizers

Plasticizer	*SP of plasticizer*	*Cellulose acetate, (SP=10.9)*	*PVC, SP=9.7 (calc. SP=9.5)*
dimethyl phthalate	10.5	C	I
diethyl phthalate	9.9	C	I
dibutyl phthalate	9.4	(C)	C
dihexyl phthalate	9.1	I	C
dioctyl phthalate	8.9	I	C
didecyl phthalate	8.8	I	C
dioctyl adipate	8.6	I	(C)
triphenyl phosphate	10.5	C	(C)
tricresyl phosphate	9.7	I	C
butyl epoxystearate	9.7	I	C
butyl oleate	9.0	I	(C)

C=Compatible
(C)=Marginal compatibility
I=Incompatible


Housewives have a

versatile friend in Eastman's Polyethylene

It's easy to see why housewives buy so many housewares made of Tenite Polyethylene.

This Eastman plastic has properties made to order for household duty.

Tenite Polyethylene is colorful, strong and tough. It is light in weight, flexible and practically unbreakable. It does not chip or dent even when struck or dropped. Resilient, it resists permanent deformation and affords airtight seals for containers and closures, providing an effective barrier to moisture and odors.

Tasteless and odorless, it is ideal for food containers. Its soft surface minimizes kitchen clatter and also prevents marring of delicate surfaces.

Properties like these help Tenite Polyethylene aid housewives in many other ways. Polyethylene film, containers and paper coatings for packaging use are now familiar to everyone. And, unseen to the housewife are numerous Polyethylene components such as dishwasher pumps, tubing, wire insulation and television tube shields that add life to household equipment.

Tenite Polyethylene has found diverse jobs in many fields. This versatile plastic can give a selling lift, better performance or longer life to many of the products you sell. For more information on the many desirable properties of Tenite Polyethylene, write EASTMAN CHEMICAL PRODUCTS, INC., subsidiary of Eastman Kodak Company, KINGSPORT, TENNESSEE.

TENITE

POLYETHYLENE

an Eastman plastic

Fig. 6: Three-layer packets for food and other products are laminated with bodied cement. (Photo, Celanese Corp.)

SP range 9.4 to 10.4; but not with polystyrene, which falls just below this range, or the cellulose esters, which are slightly too high. And there are many pairs of polymers which are incompatible even though they share a common SP. Polymers are not good mixers.

The main obstacles to be overcome in bonding two plastics are the difference in SP, and plasticizer migration. To take care of SP differences, a polymeric adhesive should be selected which covers as wide as possible a range of SPs. As already mentioned, this means one of the amorphous polymers at the left in Fig. 4. Nitrocellulose dopes are effective for cementing together cellulose acetate and cellulose acetate-butyrate. Buna N rubber, the butadiene-acrylonitrile copolymer, sometimes blended with a vinyl chloride copolymer, is utilized for bonding the vinyls.

In Fig. 6, above, are shown some envelopes for drugs, coffee, etc., which are made of adhesive-bonded laminated sheeting. The outermost layer, reverse printed on the inside surface, is cellulose acetate. Laminated to the acetate is a layer of 0.0007-in. aluminum foil. Bonding may be done with vinyl acetate or chloride copolymers, cellulose nitrate, or Buna N rubber, in a mixture of solvents of marginal SP for cellulose acetate, e.g., toluene and isopropyl acetate. Inside, the foil is thinly coated with vinyl for heat sealing. The package is attractive, strong, and impermeable to water, oil and gases.

Plasticizer migration may occur when one of the adherends is a plasticized vinyl or a cellulosic. It may cause crazing when the other adherend is polystyrene or polymethyl methacrylate. The most obvious remedy is to use a harder formula of the plasticized component. Sometimes it is feasible to switch to a closely related material which requires less plasticizer: from PVC to the chloride/acetate copolymer; from cellulose acetate to propionate or butyrate.

In vinyls, the higher-molecular-weight, straight-chain polymeric plasticizers are non-migrating. The preferred plasticizers for both vinyls and cellulosics, when they are to be in contact with polystyrene or acrylics, will be those having the higher SPs since they are less likely to emigrate to the lower SP resins.

Table III: Energy-to-break of typical plastics[a]

Material	*Approximate tensile strength × elongation,* in.-lb./cu.in
6/6 nylon	9500
polyethylene	8000
cellulose esters	4500
rigid polyvinyl chloride	800
acrylics	800
polystyrene	300

[a]Source: Modern Plastics Encyclopedia issue, Sept. 1955.

Plastics-to-other materials

Plastics are often bonded to metals, glass, paper, cloth—polar materials with high SPs. Fortunately, many polymeric adhesives are available which contain hydroxyl groups capable of adhering to surfaces made of these polar materials. Among them are proteins, starch and dextrins, gums, polyvinyl alcohol (actually a copolymer with acetate), polyvinyl butyral, cellulose nitrate, vinyl chloride copolymers with maleic anhydride, polymethacrylic acid, amino resins, phenolics (aromatic hydroxyl), epoxies, and others. Those that are most diverse in makeup, such as the epoxies and polyvinyl butyral, are most likely to bond a plastic to a non-plastic successfully.

Composite adhesives, in which metal is primed with a phenolic, for example, and then coated with vinyl, are in use both here and in England.

Adhesive layer requirements

Aside from covering the solubility span, the adhesive layer must fulfill certain rheological requirements.

When applied, it must have a low viscosity in order to spread and adhere to the surfaces. But for good cohesion in the cemented part, the adhesive layer must soon increase in viscosity or even be cross-linked. Several routes are available to reach these conflicting demands on viscosity:

1) Solutions (dopes, cements) of polymer in organic solvents. These give good bonding and the characteristics of the final bond, after all solvent has been removed, are predetermined by the known properties of the polymer base. Unless at least one of the adherends is porous, all the solvent must be evaporated after the adhesive is spread on and before the surfaces to be bonded are joined together, since negligible solvent will be absorbed by the adherends. In such cases tackifiers may have to be added to the

(*To page* 236)

Balsa cores for reinforced plastics structures

*By Richard Mark**

Many thick sections or parts made of reinforced plastics require the use of core materials to reduce weight and cost while keeping stiffness. These and other functions of cores are discussed. Of the available core materials, balsa woods have superior strength and fatigue properties for their weight and cost. The more useful methods of forming balsa cores for curved structures are taken up in detail. Properties of balsa woods important to their use as core materials are given.

For over two decades, balsa wood has been employed as a structural core for aircraft sandwich construction. This use of balsa has been extended in the past five years to include many applications in reinforced plastics where thick sections are required for thermal insulation and/or rigidity. Most of these reinforced plastics applications are non-military, and enter into daily life in the form of tank trailers that transport bulk milk and orange juice; ladders for use in telephone line service; pleasure craft; and others.

The most important job of a bonded core material in sandwich constructions is to stabilize and stiffen two thin facings having relatively high tensile strength so that the major part of a load is borne by the skins. The bonded core also converts the two skins into a single structure of great rigidity, so that they deform much less under load than they would unjoined. To serve these purposes the core material must have high compressive, shear, and tensile strengths, and a fairly high modulus of rigidity in shear.

In many cases the core must also serve as a thermal or electrical insulator, so that low thermal conductivity and high dielectric strength are desirable. Sometimes, to get stiffness, a laminate must be thick, stiffness being proportional to the third power of the thickness. A thick section made entirely of a glass-resin laminate would be very heavy; nearly the same rigidity can be obtained with great reduction in weight by using two thin skins and certain low-density core materials.

In boats, motor vehicles, and aircraft, the use of lightweight core materials can result in a distribution of weight favorable to high stability. Boats, water

*Balsa Ecuador Lumber Corp., New York, N. Y.

Fig. 1: Marine Corps field shelter is constructed of ribbed spherical and cylindrical reinforced plastics panels. Figures 9, 10, and 11 show forming operations for curved ribs made in the panel molds of this shelter. (Photo, Auth Electric Co.)

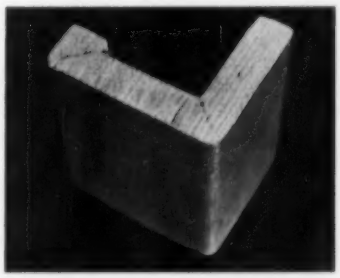


Fig. 2: Sandwich panel of reinforced plastics skins laminated to a flat-grain balsa core, notched at two points, bent, and trimmed. (Photo, Bassons Industries)

Fig. 3: Aircraft sandwich panel; end-grain balsa core for panel was formed by draping. (Photo, Chance Vought Aircraft, Inc.)

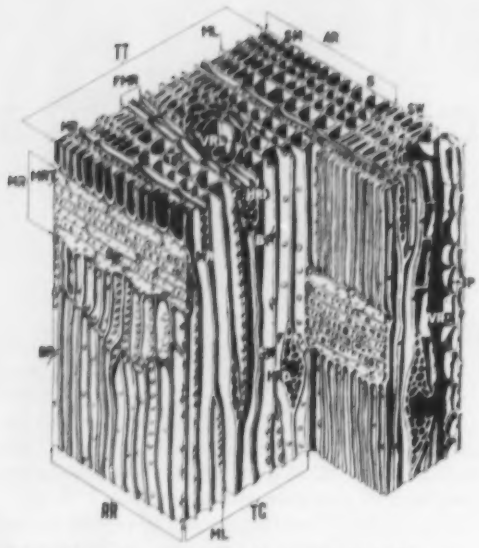
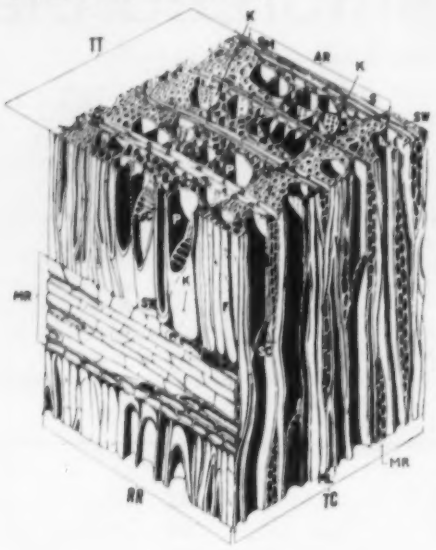


Fig. 4: Cell structure of a minute block of softwood, about 1/32 in. on a side. Wood structure is essentially a compact honeycomb of long cells called fibers which run along the grain. There is a small percentage of ray cells (MR) which run from bark to center of tree. (Drawing, U. S. Forest Products Laboratory)

Fig. 5: Cell structure of a minute block of hardwood, approximately 1/32 in. high. The same basic orientation of fibers and ray cells exists in all types of woods. (Drawing, U. S. Forest Products Laboratory)



skis, etc., can be made unsinkable by replacing dense centers with buoyant core materials.

Often the finished reinforced plastics product is subject to high compressive and/or impact loads. The core material must absorb and distribute such loads. To do so it must be resilient, tough, and have high compressive strength.

Finally, since core materials are usually less costly than the resin and reinforcing components in plastics products, they are sometimes used simply to reduce the over-all cost of the finished product.

Most theoretical calculations ignore the presence of the core material and assume that the entire load is carried by the strong-in-tension outer skins. Nevertheless, the core may also contribute substantially to the properties of the finished laminate. The most striking differences can be seen when two identical reinforced plastics products are made using two different core materials of the same density. The difference in the rigidities of the two cores will show up as substantial changes in deflection under equal loads and a noticeable change in the yield stress.

Balsa possesses the highest strength/weight ratio of all core materials in almost all its strength properties and so yields laminates superior in strength and stiffness to others. The differences are particularly appreciated after a part subject to shock or vibration has been in service for some time and the effects of fatigue are felt.

Because of their rigidity, the largest use of balsa cores has been in flat panels or straight beams. However, this core material is by no means restricted to such uses, and its importance for curved structures has been steadily mounting. This paper describes the commercial techniques which

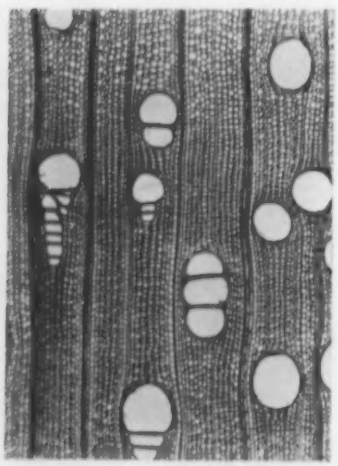


Fig. 6: Photomicrograph of balsa, corresponding to TT surfaces in Figs. 4 and 5, enlarged 25 times. (Photo, N.Y.S. Coll. of Forestry)

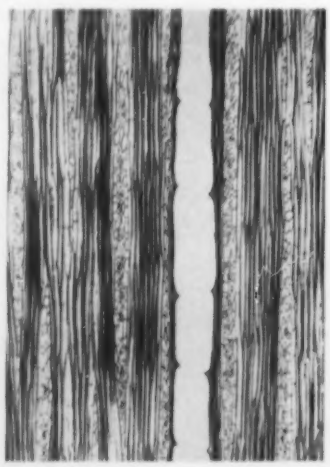


Fig. 7: Photomicrograph of balsa, corresponding to TG surfaces in Figs. 4 and 5, enlarged 25 times. (Photo, N.Y.S. Coll. of Forestry)

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have been developed to form this core material to contour. Samples of the kinds of curved structures considered here are pictured in Figs. 1, 2, and 3, which are, respectively, cylindrical-spherical, right-angular, and doubly curved.

Microstructure important

To correlate shop practice in a forming operation with an understanding of what is actually happening to the balsa microscopically—how its cells are being deformed—it is necessary first to examine the structure of small magnified sections of wood. There are no two species of wood which are the same; yet all woods have the same basic two orientations of their elements. These orientations are *a*) along the length of the tree trunk and *b*) from the periphery of the log to the center, like spokes of a wheel. The drawings in Figs. 4 and 5, p. 132, are of pine and hardwood, respectively, enlarged about 25 times. The long tubular honeycomb which makes up most of the wood is comprised of fibers, vessels, and food-storage tissues which, for convenience, are referred to simply as "fibers." These cells run along the grain of the wood.

The other group, which runs radically (and discontinuously) to the center of the tree is composed of cells known appropriately as "ray cells." They are identified on the diagrams by the letters "MR."

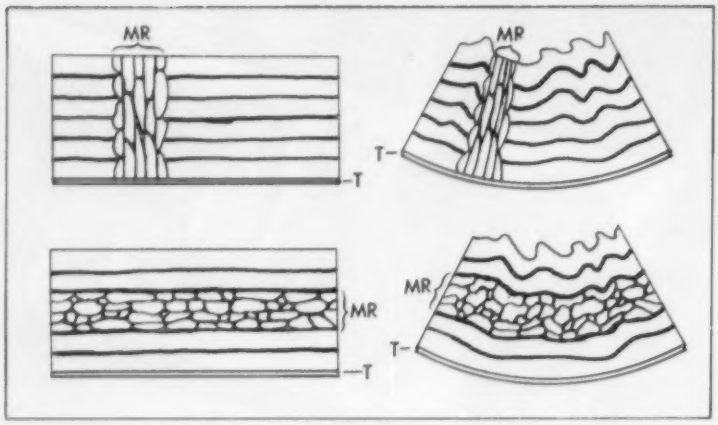


Fig. 8: Diagrammatic drawing of microscopic effect of bending balsa along the grain with tension face restrained from elongating by means of tension strap (T). Each wood fiber undergoes buckling which becomes progressively more severe toward the concave side. These views show that ray cells (MR) have little effect on bending results. Consequently, commercial forming operations do not have to consider grain alignment in bending parallel to the grain

Balsa, also, exhibits these two types of cellular elements. In balsa the rays make up about 23% of the wood by volume; longitudinal fiber units make up the rest.

Two enlarged photomicrographs of balsa are shown in Figs. 6 and 7, p. 132. The view in Fig. 6 corresponds to the TT surface shown in the composite block drawings in Figs. 4 and 5; Fig. 7 corresponds to the TG surface in the drawings.

Bending along the grain

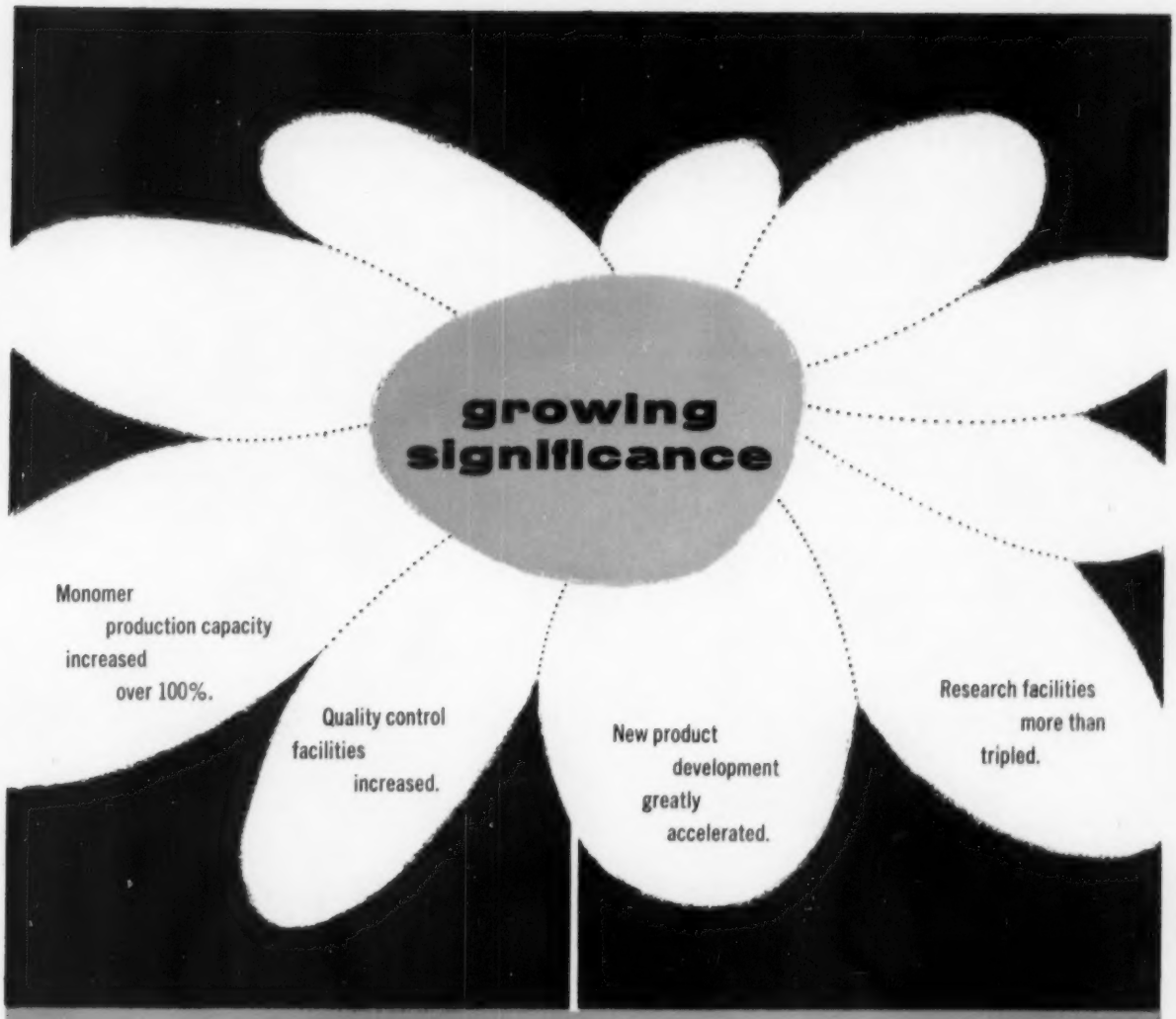
Now, it is evident that any forming technique will predominantly affect the fibers, with the ray cells exerting a modifying influence on the operation.

One of these techniques in-

Fig. 9: Prebending after soaking in hot water for 1½ hr. in tank shown in background. Balsa core is dried while clamped to the form in foreground. Note that form has two curves; the lower one is the true curve, the upper one, on which stock is being bent, has been elevated 4 in. at the center. Total rib length is 8 ft., and the radius of curvature of the true curve 10 ft. (Photos, Auth Electric Co.)

Fig. 10: Balsa rib cores and glass cloth are placed on cylindrical mold. The rib at left was formed by soaking, rib at right was formed by tension strap

Fig. 11: Section of curved rib, removed from mold and trimmed, shows transverse ribs. Balsa core was formed by hot-soaking and jig-forming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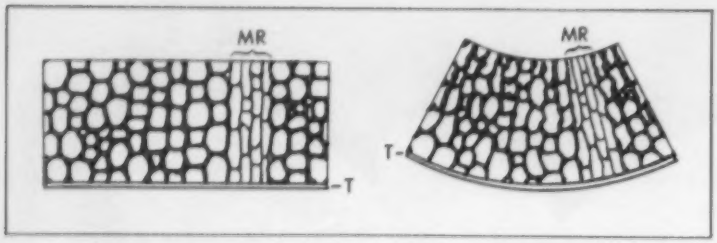

Fig. 12: Diagram of the microscopic effect of bending balsa across the grain, with the tension face being restrained from elongating by a jig (T). Each fiber cell compresses slightly. In this view, the ray cells (MR) are aligned perpendicular with respect to the bend and therefore have no effect on the bending

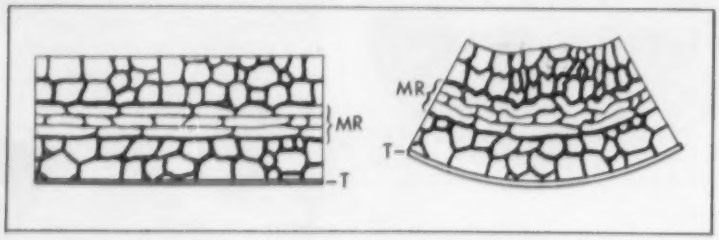

Fig. 13: Diagram of bend identical to that shown in Fig. 12, above; however, in this case, ray cells are aligned parallel to bend. In critical bends, shear failure may occur along the rays; but ordinarily, the effect of this alignment is negligible

volves bending along the grain, but it should be emphasized that this is commercially the least important of the methods of forming balsa cores for reinforced plastics. It is discussed first because it is the most familiar. Everyone has seen chair backs, barrels, and boat ribs made from bent wood members. These are all examples of bending parallel to the grain.

The two techniques most used for making simple (unidirectional) bends with this grain orientation are: *a*) preforming by tension strap and *b*) preforming with hot water or steam.

In method *a*), use is made of the fact that wood is easier to compress than it is to stretch. A restraining strap is applied to that side of the balsa beam or panel which is to become convex, i.e., the tension side. At the same time, the ends of the piece are restrained lengthwise and the net result is virtually to eliminate tension in the convex side as bending force is applied.

Deformation under this arrangement takes place predominantly on the concave side of the balsa. It causes microscopic buckling of the wood fibers, illustrated diagrammatically in Fig. 8. It can be seen that in this case the orientation of the ray cells (MR) does not exert too great an influence on this buckling action. The *T* denotes the tension strap. Steel straps are most commonly used to restrain the tension face and the ends are restrained by blocks which are adjustable to compensate for the high end pressures induced by severe bending.

Method *b*) employs an entirely different principle. Here, by softening or plasticizing with steam or hot water, sometimes in the presence of chemicals such as urea, the fibers and rays in the wood adjust themselves to the distortions imposed by bending to a greater extent than would be possible without this treatment. Combinations of methods *a*) and *b*) can be used to produce radii of greater severity than can be accomplished with either method alone, and with denser woods this is standard practice.

It is desirable to overform the balsa core prior to molding to allow for elastic recovery of the compressed fibers. The amount of overforming depends on thickness and radius of curvature and can be easily ascertained by one or two trial bends. Figure 9, p. 134, shows the forming of a rib in the mold for the reinforced plastic shelter of Fig. 1, p. 131.

After the rib cores are formed they are placed in the mold, wrapped with glass cloth, and the resin is spread on. Figure 10

(*To page* 141)

Fig. 14: Sandwich panel having slight curvature being molded on the convex side of a metal mold. Core curvature for this radius is achieved by draping, which has been employed in both end-grain and flat-grain orientations. (Photo, U. S. Forest Products Laboratory)

Electric typewriter keys molded from BAKELITE Brand C-11 Plastics. See next page for details.

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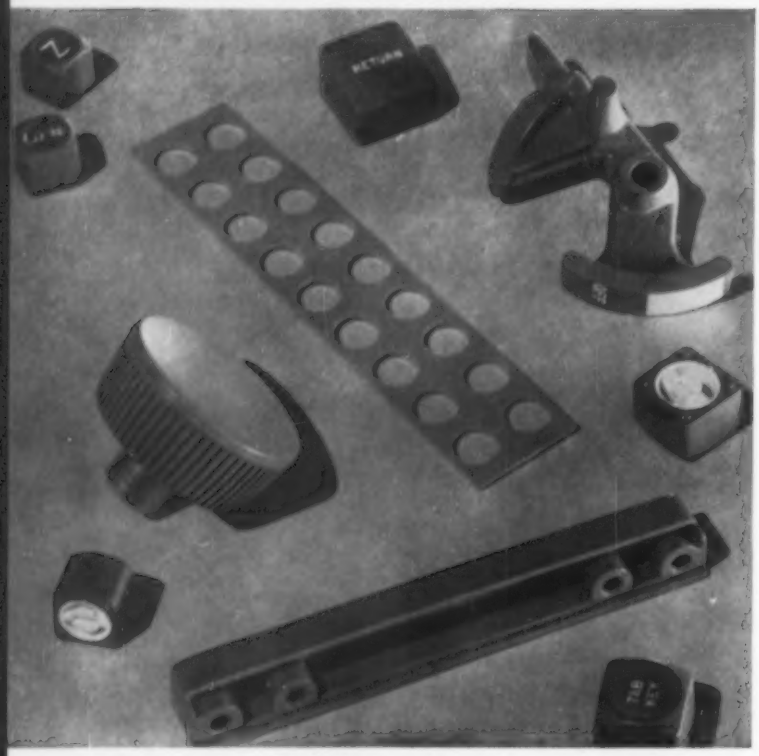

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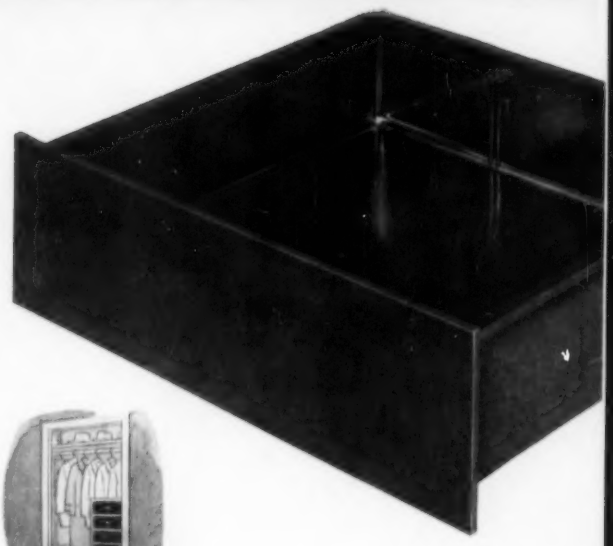

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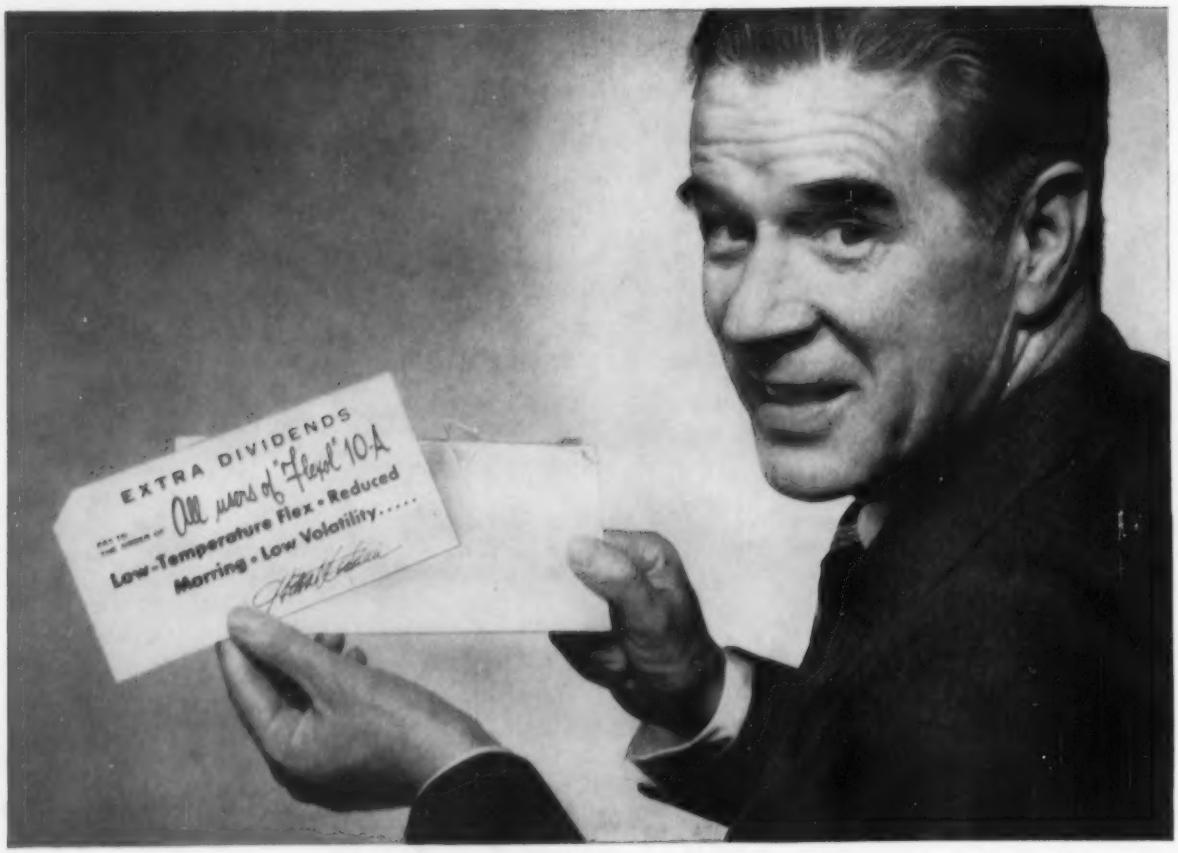

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Fig. 15: One method of bending an end-grain balsa core after lamination of one facing. Photos on this page illustrate the technique described under method d) p. 142

Fig. 16: After one facing has been bonded to end-grain core and assembly bent, other facing can be applied to core for secondary molding operation. In photo above, the concave-side facing and the bent core have been placed over male mold prior to molding. (Photos, U. S. Forest Products Laboratory)

Fig. 17: Bag molding of an end-grain core sandwich in a female jig. As with the sandwich shown in Fig. 16, the convex-side facing has been bonded and the assembly bent prior to insertion in female mold

shows the ribs in the mold in the process of being wrapped. In Fig. 11 is a sample section of balsa-cored rib that was cut out after curing.

Bending across the grain

Bending perpendicular to the grain is commercially the most important mode of bending for balsa-core applications outside the aircraft industry. A microscopic analysis of this type of bend is shown in Figs. 12 and 13, p. 136 (*T* represents the restraining jig). Instead of the columnar buckling of the fibers which takes place in bending parallel to the grain, there occurs only a comparatively gentle compression of the cells along the concave face. Again the ray cell (MR) orientation does not ordinarily have an important enough effect to require consideration for practical purposes.

The restraining principle is used extensively for severe bends, while the inherent flexibility of wood in this direction also permits extensive use of a simple method known as "draping." Discussed below are two methods of drape forming and three that use some technique of restraint, namely:
a) Draping of a prebonded panel; *b*) draping as a "floating core;" *c*) restrained jig bending of strips; *d*) lamination of one face prior to formation of core; *e*) lamination of two facings prior to formation of core.

Fig. 18: Trimmed, curved, end-grain balsa core sandwich produced by the method of laminating one skin prior to bending. This panel has a balsa core ½ in. thick with minimum radius of about 2½ inches

Draping

If a thin panel is laid on either a male or female mold, it will drape or sag across the grain and tend to assume the mold curvature. This permits molding of the type shown in Fig. 14, p. 136. The technique is adaptable to metal facings which have been coated with adhesive as well as to wet layups in reinforced plastics. It is also adaptable to both end-grain and flat-grain balsa and to several types of molding methods.

Floating core

Instead of using a one-piece panel of balsa for the core, it is possible in many cases to simply lay loose strips of balsa side by side so that their lengths are parallel to the direction in which there is no curvature. When the curved sandwich is formed, the loose strips will stay together at the concave surface but will spread apart a little at the convex (outer) surface. Thus, in the finished molding they will be separated by narrow triangular slots. A core so made is called a "floating core."

When the strips are first laid in place they are dry. However, as the cloth and resin are applied, some of the resin seeps into the slots and actually edge-bonds the strips together as the surface laminate is curing.

This method has limitations: 1) the slots may become too wide in sharp bends and 2) a female mold must be used.

Restrained jig bending

When small radii of curvature or thick sections are needed, method *c*) employs the same principles which were outlined in

Fig. 19: View of aircraft plant fabrication area for balsa blocks before conversion to end-grain sandwich cores. Block at left (1) is curing in press; blocks at right (2) are ready for band sawing. Two of these (3) are trimmed. (Photo, Chance Vought Aircraft, Inc.)

the earlier discussion on tension straps.

A tension strap can be any width and, in the case of bending balsa panels or several strips across the grain, they take the form of jigs or cauls of sheet steel with long bars for pressure blocks. An edge-bonded panel or a suitable number of core strips are placed between the pressure bars. This loaded caul is placed between the curved platens and the press closed. The sheet steel and the balsa assume the mold curvature. The bars prevent any stretching along the convex face, effectively restraining it and resulting in compression of the concave face. It may be necessary to overform slightly to compensate for springback.

Instead of using a sheet of steel to restrain the face under tension while forming the balsa, it is possible to laminate one or both faces of the balsa core to the reinforced plastic skin and then use the bonded skin to restrain the wood under tension.

In method *d*), a technique is used whereby one facing of reinforced plastic is laid on the balsa core, whether it is in strip or panel form. This layup is allowed to cure as a flat laminate. In this condition the panel can be bent to rather severe radii, since the face of the balsa core is fully restrained by its intimate bond to the skin. The core can be formed in a press while another skin is being laminated to it, or it can be preformed to varied curvatures prior to secondary bonding of the compression-face skin material. Once the second facing has cured, the curvature is permanently set. Figures 15 through 18, p. 141, show the bending of end-grain balsa cores, and illustrate the techniques just described for method *d*).

Method *e*), which is a refinement of *d*), has great potential, since it permits faster assembly in some cases and can be used for making very sharp bends like those shown in Fig. 2, p. 131. The procedure is to lay up the resin and reinforcement of both facings on flat panels or strips and allow this layup to cure as a flat sandwich. Notching the sandwich panel at the desired location makes it simple to fold these corners in an appropriate jig.

Using this technique, all four walls of a no-draft container can be formed simultaneously by folding up such a flat sandwich panel. To obtain various exterior corner radii, the slope and depth of the notch is varied. Resin is applied to the notch to form a bonded joint on closure, and a bead of resin can be added at the inside corner for a waterproof seal. This method uses the facing on the convex side as the tension strap, so the type of compression shown in Figs. 12 and 13 still obtains, but over a thinner cross-section.

Combinations of one of these forming methods and one of the methods used to bend balsa along the grain can be employed to produce slight compound curvatures. As a general rule, the more difficult bend is made first.

End-grain forming

Thus far two types of bending have been described. Both of these have been with reference to balsa core strips and panels having conventional grain directions, referred to collectively as "flat-grain."

When, on the other hand, many

Properties of balsa wood of three densities[1,2]

Property	*Density, lb./cu. ft.* 5	9	14
Specific gravity	0.080	0.144	0.224
Compressive strength, p.s.i.			
A) End-grain			
Stress at proportional limit	300	1050	1900
Maximum crushing strength	550	1440	2600
Modulus of elasticity	210,000	580,000	1,000,000
B) Flat-grain[3]			
Stress at proportional limit	40–70	80–115	130–180
Bending strength, p.s.i.			
Static bending			
Stress at proportional limit	600	1350	2275
Modulus of rupture	1050	2375	4000
Modulus of elasticity	210,000	485,000	825,000
Tensile strength, p.s.i., flat-grain	65–100	100–145	145–205
Toughness, flat-grain, in.-lb. per specimen	90	210–235	355–420
Shear strength, flat-grain, p.s.i.	130–145	245–290	385–475

[1]Data from: "Strength & Related Properties of Balsa Wood," By C. A. Wiepking and D. V. Doyle, U. S. Department of Agriculture, Forest Products Laboratory Report No. 1511, June 1944.
[2]Data for pieces averaging 12% moisture content, bone dry basis.
[3]Data are average values at different orientations.

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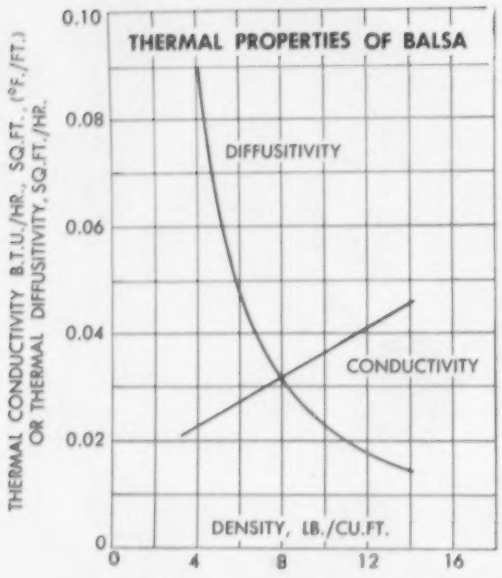


Fig. 20: Thermal properties of balsa are dependent on density. Moisture content also affects them, and these conductivities are for balsas containing 12% water. They were computed from a formula furnished by U. S. Forest Products Lab. (Tech. Note No. 248, Apr. 1941). Diffusivities were estimated by assuming specific heat is equal to specific gravity, a reasonable assumption for woods

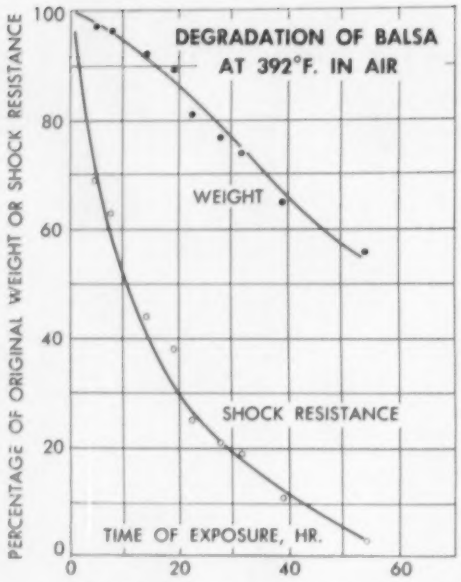


Fig. 21: Oxidative degradation of balsa

pieces are bonded together to form a large block of the type shown being made in Fig. 19, p. 142. This block is resawn across the grain, wafers or slices are obtained with the grain running at right angles to the thickness of the slice. This is the same grain which results when a thin disk is cut from the end of a log. It is called "end-grain."

End-grain, because of its fiber orientation, is extremely stiff and has high compressive, tensile, and shear strength values. For example, the compressive strength at proportional limit for end-grain (9 lb./cu. ft.) is 1050 p.s.i., or ten times as great as the comparable strength values for flat-grain (see Table I, p. 142). Shear moduli in excess of 20,000 p.s.i. have been recorded for end-grain of 8 lb./cu. ft. density.

For these reasons, end-grain is the preferred orientation for balsa used in aircraft sandwich fabrication, whether the facing material be metal or reinforced plastics. It is formed by the methods used with flat-grain.

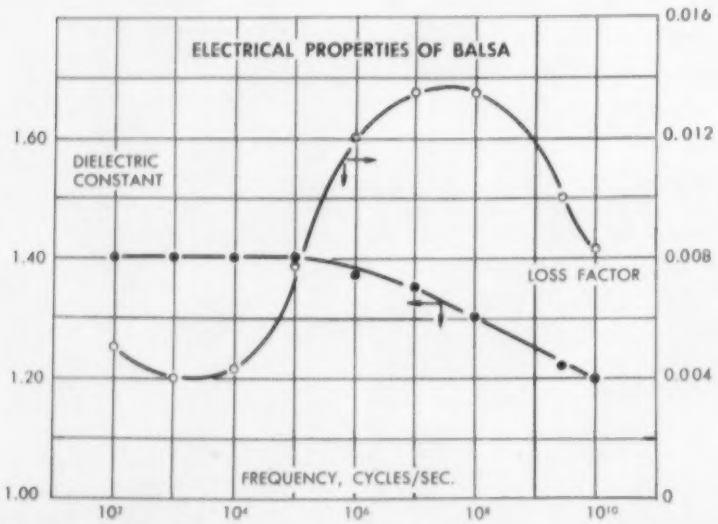


Fig. 22: Dielectric constant and loss factor of balsa *vs.* logarithm of frequency. Data by M.I.T. Lab. for Insulation Research

Laminated curved cores

Another method of forming curves and angles is by laminating curved strips. By layering together two or more thin strips or sheets of veneer, sharper curvatures are attainable over a given thickness than would be possible in solid wood, other things being equal.

Balsa cores of two or more plies can be formed this way. If several layers of veneer are bonded in a curved mold, they will hold this mold curvature, except for moderate springback.

Other core forming methods

In addition to various types of bends which can be performed on balsa to create desired curvatures, the subject of commercial forming methods would not be

(*To page* 238)

Advances in thermoset molding

*By E. F. Borro**

Faster curing materials, preheating of feeds, faster machines, and increasing automation have tremendously reduced the cost of thermosetting molding operations. This article presents data showing that curing time can be cut to half or less by preheating, by using a hot mold, and by feeding the stiffest material possible. Recent developments in equipment, techniques, and automation are surveyed. Particularly illustrative of the newest trends are several cases of completely automatic molding-in of metal inserts.

Techniques and methods in phenolic molding have continually been improved. The most notable progress, however, has been made within the last 15 years after the introduction of high-frequency preheating and automatic molding. In addition, the development of new molding materials that cure faster and flow more easily has been partly responsible for some of the progress in the molding techniques and for the development, in turn, of faster molding equipment. Finally the productivity of modern self-contained presses completely eclipses that of the presses of the early days.

In order to remain competitive, molders have to take every advantage of newly developed techniques in order to achieve the greatest productive efficiency. Since the objective is cost reduction, every phase in the initial stages of the development of the molded part must be studied, with great emphasis on getting the right material for the specific application. Often the material is the deciding factor in the choice of the molding technique. Selection of the material should be based not only on its performance in the molded part, but also on its flow

From a paper presented at the Niagara Falls and at the San Francisco S.P.I. Conferences in March 1956.

*Chief design and development engineer, Durez Plastics Div., Hooker Electrochemical Co., N. Tonawanda, N. Y.

Table I: Effect of mold temperature on flow

Mold temp.	*Material temperature*	*Mold-closing time at 2500 p.s.i.*
°F.		*sec.*
270	cold	25
320	cold	18
340	cold	16
370	cold	10
320	preheated	2

Table II: Effects of molding variables on curing of Durez material 791 in compression molding of cups

Form of feed	*Preheat temp.*	*Mold temp.*	*Curing time of materials with plasticities**		
			6	*8*	*12*
	°F.	*°F.*	*sec.*	*sec.*	*sec.*
Powder	80	310	90	110	135
"	"	330	85	105	125
"	"	350	80	100	115
"	"	365	70	95	105
Powder	240	310	75	75	85
"	"	330	65	70	75
"	"	350	55	60	65
"	"	365	50	55	60
Preforms	260	310	55	60	65
"	"	330	45	55	60
"	"	350	35	45	50
"	"	365	30	35	40

*Plasticities were measured according to ASTM test D731.

Table III: Effects of mold temperature and plasticity on curing of Durez 791 in transfer molding of 5-by ½-by ½-in. bars

Form of feed	Preheat temp.	Mold temp.	Curing time of materials ASTM plasticities		
			6	8	12
	°F.	°F.	sec.	sec.	sec.
Preforms	265	320	30	45	66
"	"	340	27	42	54
"	"	355	24	39	51
"	"	370	21	36	45

Table IV: Effect of flash allowance on cycle time

Allowance	Closing time	Curing time	Total cycle
% charge	sec.	sec.	sec.
2	14	46	60
5	16	49	65
10	19	56	75

characteristics and the time required for cure.

Plasticity of the material controls the molding pressure requirements, speed of mold closing, and size of mold. Equipment and design of the part permitting, the stiffest possible material should be selected so as to get the fastest cure. It is recognized that the stiffer materials require higher molding pressures but that they are generally faster curing. Within certain design limitations, however, particularly at equal molding pressures, the softer materials can often be molded in the same time, because the faster mold closing allows heating to start sooner. A long mold-closing time often causes case-hardening of the surface. This in turn results in entrapment of gases and volatiles, so that a more complete cure (and longer curing time) is needed. In one case, for example, 100 sec. were required to cure a medium-flow, general-purpose material at 2630 p.s.i.; 23 sec. of this time were spent in closing the mold. At 3945 p.s.i., the total time was 80 sec., 16 sec. of which were spent in closing the mold. Thus the actual curing time was 77 sec. at 2630 p.s.i. and 64 sec. at 3945 p.s.i.

In order to gain the economical advantage of stiffer materials, higher pressures must be used. For example, if 15 sec. are needed to close the mold on a cup having an area of 3.8 sq. in., a wall thickness of 0.100 in., and a depth of 2.20 in., the following pressures would have to be used with general-purpose phenolics:

Plasticity	Stock pressure
	p.s.i.
extra soft	1315
soft	2630
medium	3945
hard	6275

Mold temperatures greatly affect curing rates and molding pressure requirements. Generally, the mold temperatures range from 280 to 380° F. However, temperatures of 400° F. are sometimes used on thin-section parts in compression molding, and even on thicker sections in the closed-mold technique. The effect of temperature on the flow time and pressure requirements is illustrated in Table I, p. 145. It is evident that a rise in mold temperature, by causing the material to flow faster, allows the mold to be closed sooner. Also, raising the temperature speeds the cure.

By combining high molding pressures, high mold tempera-

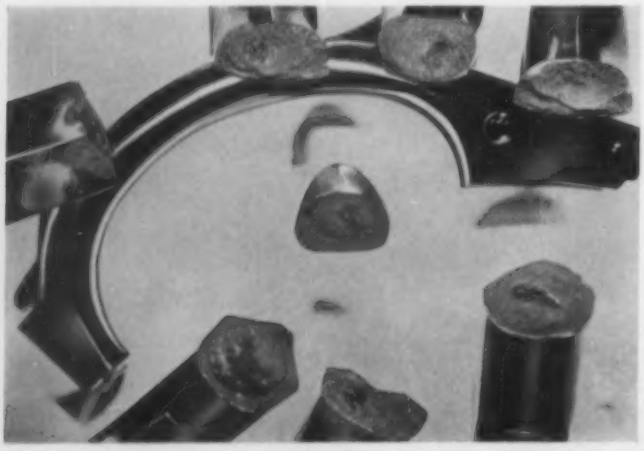
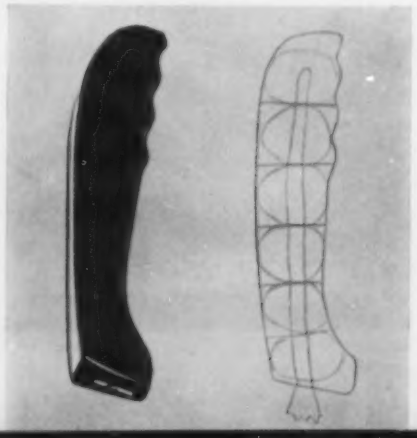


Fig. 1: Cross-sectional views of appliance handles, showing "ball-joints" produced by transfer molding operations

Fig. 2: Appliance handle; sketch shows alignment of "ball joints"



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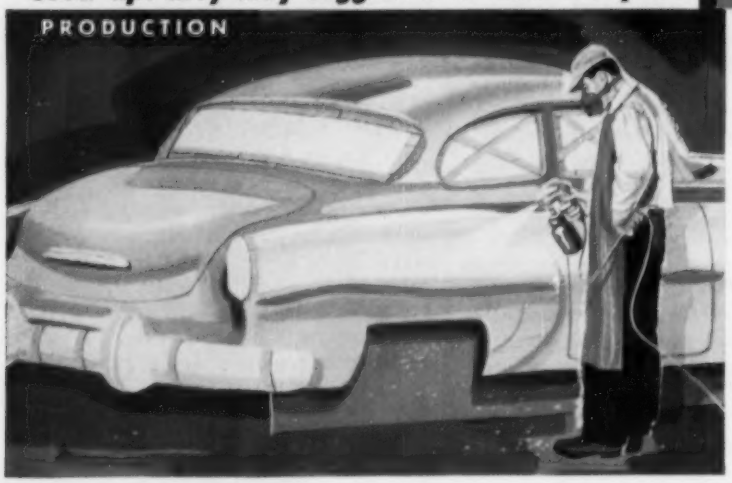

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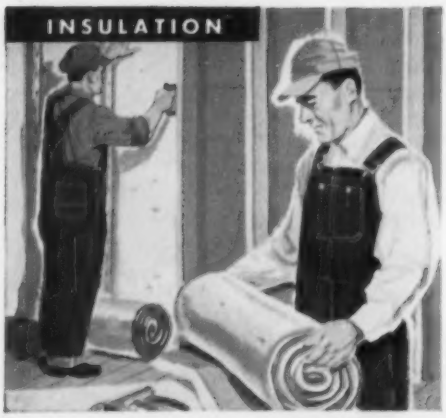

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tures, and low plasticity of material, the molding cycle can be drastically shortened. The harder materials are more completely polymerized to begin with than the softer materials, so it is to be expected that they would require less curing to reach a given final degree of cure. Higher pressures and temperatures reduce flow time and high temperatures hasten the cure. To test the magnitude of the effects of temperature and plasticity[1] on curing time in the cup mold mentioned, experiments were run in which the pressure was varied with plasticity and temperature so as to maintain constant filling time, and curing times were measured. The results are given in Table II, p. 145. Table III, p. 146, gives results of similar experiments in transfer molding.

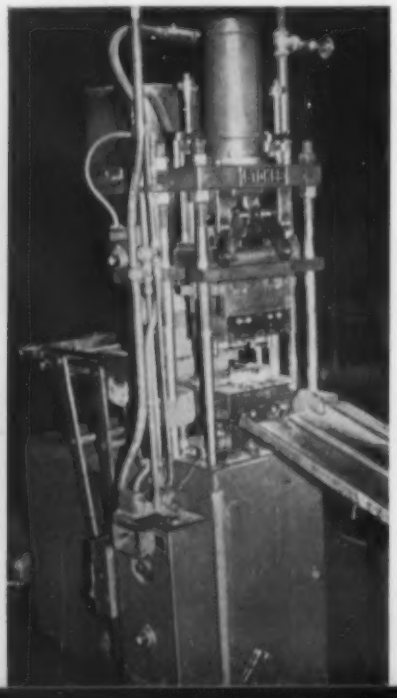
The data of Table II show clearly that under all conditions the harder materials are faster curing; a factor of 2 in plasticity makes a difference of from 15 to 30% in cure time, depending on the degree of preheating. Raising the mold temperature from 310 to 365° F. reduces cure time from 15 to 40% also depending on degree of preheating. Preheating to 260° F. has the most pronounced effect, cutting cure times to about half the cold-feed values. As can be seen from Table II, a small increase in preheat from 240 to 260° F. does as much good as raising the temperature of the feed from 80 to 240° F. This implies that it is the curing reaction rate and not the rate of heat transfer that controls the speed of curing. If higher preheat temperatures can be achieved without causing troubles with handling or flow, curing time can be reduced even more.

The data of Table III show that differences in plasticity affect curing time even more strongly in transfer molding, while the effect of mold temperature is about the same. Here the curing time for a material of plasticity 6 is less than half of that for a material of plasticity 12. Another aspect of plasticity was demonstrated in this test: the minimum plunger pressures needed at 320° F. were 14,000, 9750, and 5500 p.s.i., respectively, for plasticities of 6, 8, and 12. Since the tonnage of the press is limited, higher pressures mean smaller projected areas. For example, molding 50 sq. in. with a material of plasticity 6 would require 350 tons of clamping force. The same area with a material of plasticity 12 would require only 137 tons; or, conversely, with 350 tons of clamping force an area of 128 sq. in. could be molded with this material. Clearly, a higher initial investment in equipment is necessary to use the stiffer materials on a given size molding.

[1]All numerical values of "plasticity" given in this paper are as measured by the Durez method. The softer materials have the higher ratings.

Fig. 3: Old-time compression press of 15-ton capacity. *A* identifies spring cushion

Fig. 4: Modern 15-ton compression molding press. (Photos, F. J. Stokes Machine Co.)



Allowance for flash

Good economy depends on other factors besides fast curing materials and high molding temperatures. The allowance of surplus material for flashing bears directly on the length of a molding cycle. Table IV, p. 146, illustrates the results obtained with 2, 5, and 10% allowance. These data show that close control of material charge is important not only because it saves material, but also because it saves press time. Minimum allowance for flash and close control of charge weight can save up to 20% in cycle time.

"Ball joint" in transfer molding

In many instances, transfer molding appears economically attractive from the standpoints of mold cost, molding production, and finishing operations. But it is subject to a peculiar difficulty. In Fig. 1, p. 146, are shown sample cross-sections of thoroughly cured but case-hardened parts. The spherical lumps in the centers of these sections result from a combination of case-hardening and "ball joint." These "ball joints" are created by pushing active material in the center through the semi-cured outer shell. Fig. 2, p. 146, illustrates a molded part in which the ball joints were produced without case-hardening. The sketch on the right side shows the internal pattern of the ball joints. The effect on properties is serious: there is at least a 75% reduction in the strength of these parts. These spherical weak spots have a number of causes, among which are 1) interruption of flow due to fluctuations in molding pressure, 2) blocking of flow by large pieces of reinforcing cloth, and 3) improper placement and design of runners and gates.

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in fact, automatic molding has been in existence on single-stage, mechanically operated machines and on a 20-stage, hydraulically operated rotary machine for at least 20 years.

Figure 3, p. 148, illustrates one of the first mechanical 15-ton machines. The power is developed by a worm gear against a spring cushion *A*. This machine required 30 sec. for a dry cycle. A modern 15-ton machine is shown in Fig. 4, p. 148. In contrast to the machine in Fig. 3, the fast-acting toggle and air-cylinder mechanism of the press in Fig. 4 is capable of dry-cycling in 6 seconds.

Although there has been some development of automatic plastics molding equipment, progress has not been as rapid as in other industries. Automation is here to stay, however. The big question is: how and where does it fit into molding of thermosets? This question can be answered in part by the following survey of some of the presently operating automatic equipment and its uses.

Many custom molding plants are operating some automatic molding equipment; on the other hand, molders of proprietary products have shops that in some cases are 100% automatic. One combination custom and proprietary molder has 42 presses in the thermosetting department, 41 of which are automatic.

Two of the four rows of presses in this molder's thermosetting department are shown in Fig. 5, below. The small closure presses are in the foreground, followed by 15- and 50-ton presses. The drums of molding compound are lifted and the material is loaded into the hoppers by means of a traveling hoist. The floor grating between the rows of presses is an ingeniously conceived trough for flash. A chain conveyor carries the flash to an elevated storage tank outside the building.

Rotary machines

Figure 6, below, is a close-up of a 20-stage rotary molding machine. Molding pressure is obtained by means of a cam-track and toggle action against a spring cushion. The volumetric material-loading mechanism is a swivel arm on the right of the machine. This machine is producing radio-tube bases at a rate of 40 per min., so the curing time must be less than 30 seconds.

Several sizes of mechanical rotary machines are in use. In one plant which is entirely automatic, there are 18-stage machines with 10,000-lb. unit loads, 24-stage machines with 4500-lb. unit loads, and 36-stage machines with 4000-lb. unit loads. These machines need surprisingly little power—the 24-stage unit, for example, is driven by a 2-h.p. motor! The pressure is developed by means of roller-and-cam action against a spring cushion. Figure 7, below, shows a 24-stage machine with a top cam arrangement for ejector pins which, in this case, is used for loosening the hold of a threaded, reverse-tapered bottle cap, so that it can be unscrewed from the male half of the mold. The chain drive in front of the machine turns the

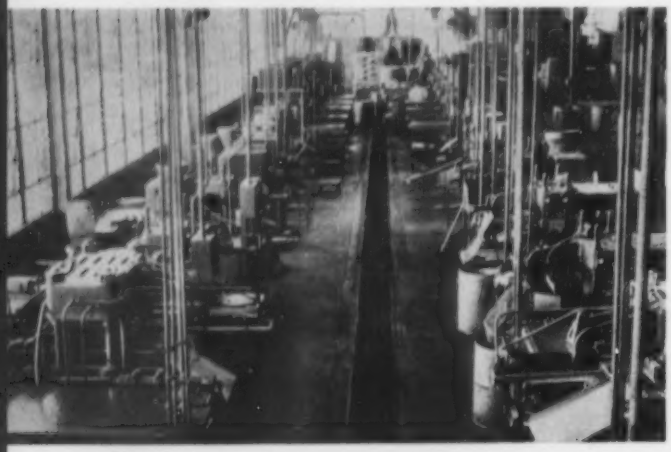

Fig. 5: Automatic compression and transfer presses in a modern plant. (Photo, Sylvania Electric Corp.)

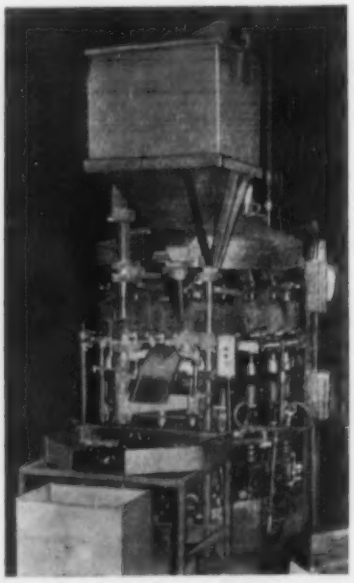

Fig. 6: Twenty-stage rotary machine making radio-tube bases. (Photo, Sylvania)

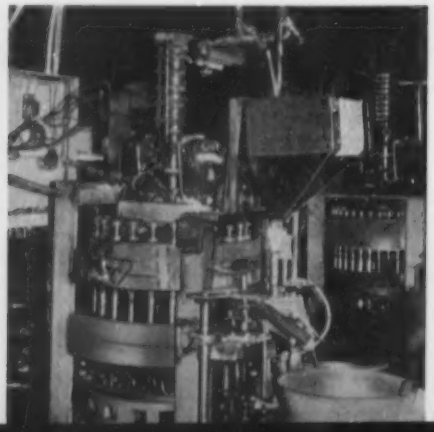

Fig. 7: Rotary machine (24-stage) molding screw caps. (Photo, Standard Cap & Molding)

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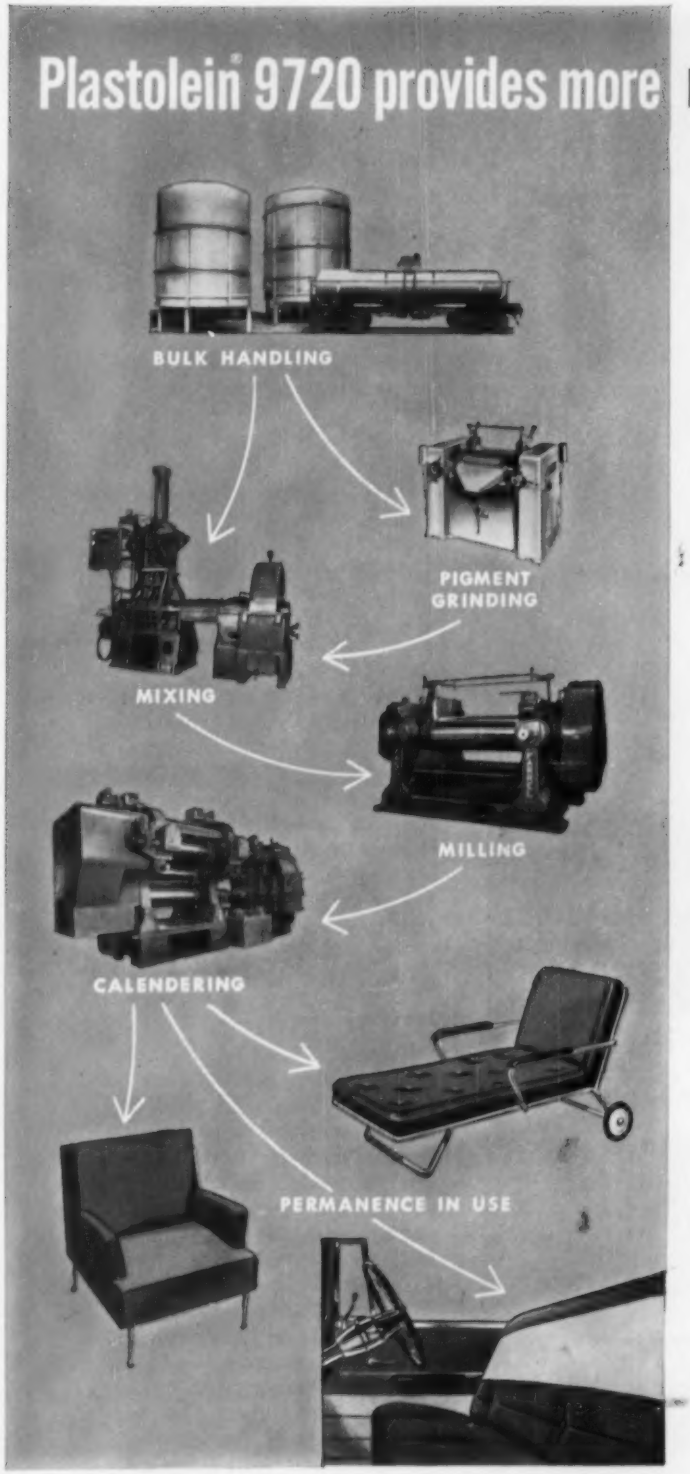

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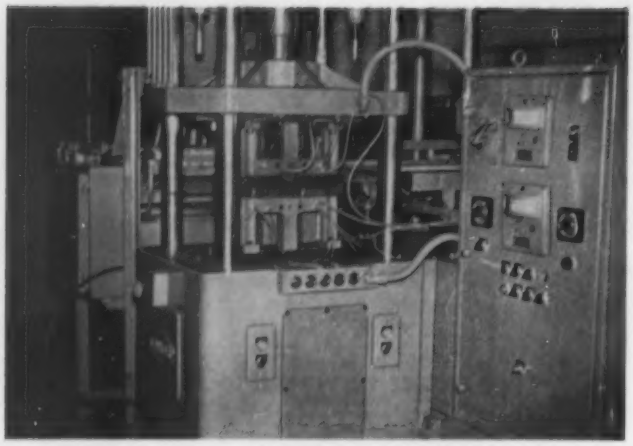


Fig. 8: Fast hydraulic molding press, showing mold and instrument panel. (Photos, Baker Engineering Corp.)

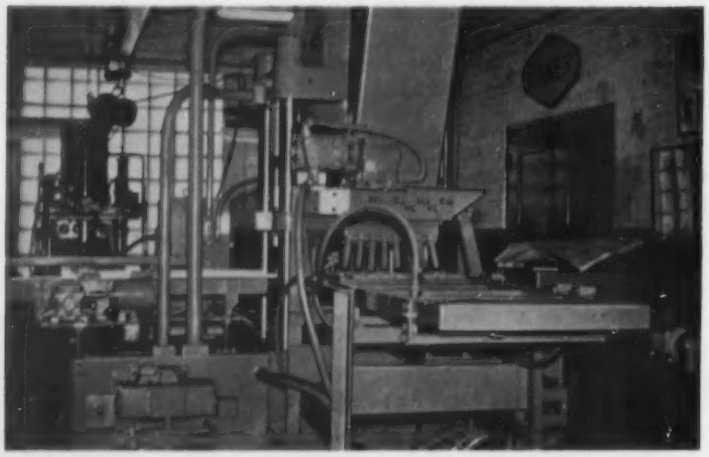


Fig. 9: Rear view of hydraulic molding press illustrated in Fig. 8, showing material hopper and loading devices

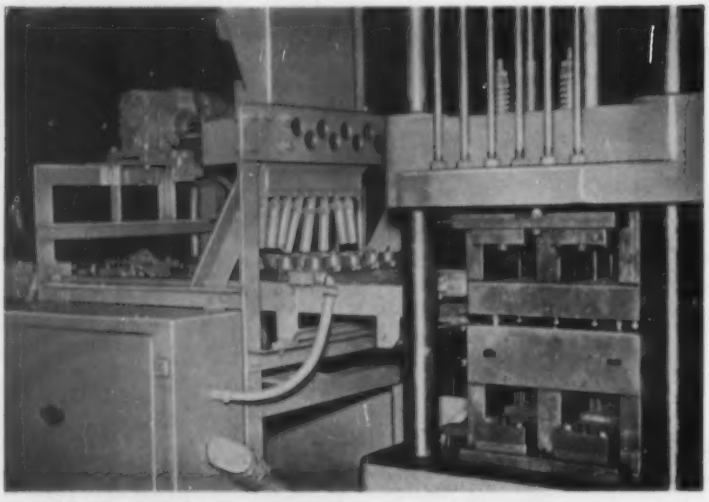


Fig. 10: Side view of same hydraulic press; feed-metering device is in center, mold in right foreground

friction wheel that unscrews the loosened caps. The operating speed is 20 to 30 caps per min. for the 18-stage, 50 to 60 for the 24-stage, and 70 to 80 for the 36-stage machine.

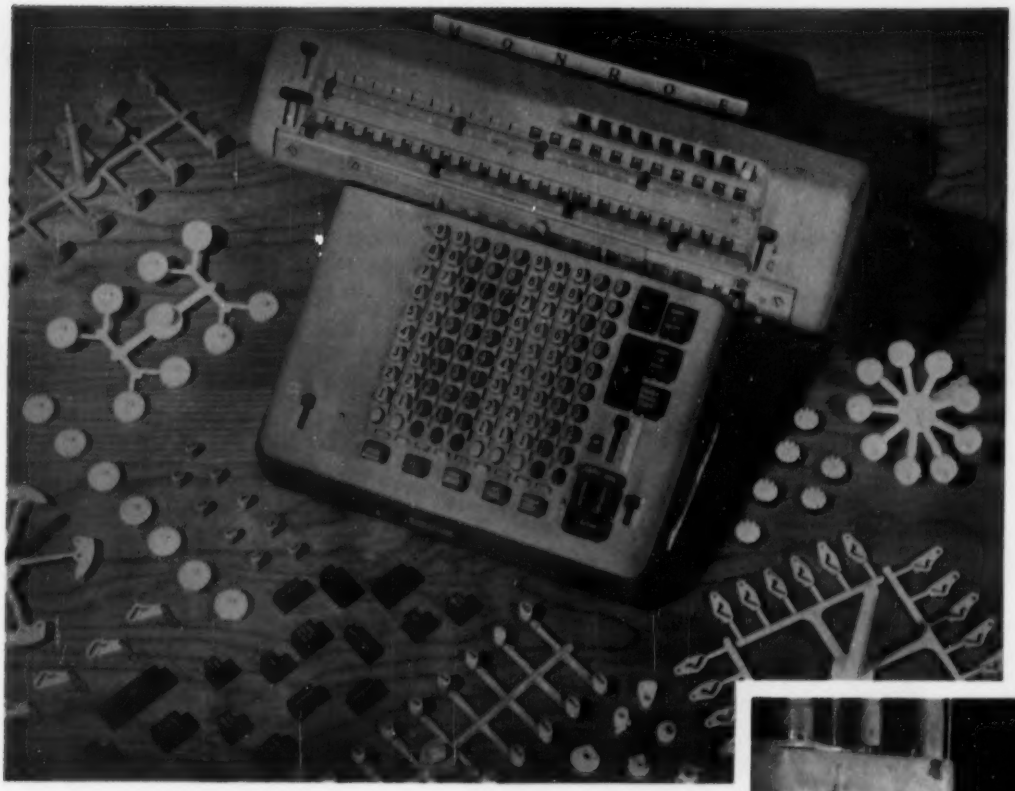
Auxiliary equipment helps

Modern equipment can help the operator to find optimum values of the variables in molding. Figure 8, left, illustrates a fast acting, automatic hydraulic molding press. The press is equipped for great versatility of production. The back of the press with the material hopper and loading device are shown in Fig. 9, left. The molded-part receiver is electrically operated with variable-speed control. Figure 10, below, shows the side of the press, the material measuring device, and the loader. The material is metered by the eight cylindrical parts below the hopper, is discharged first into the tubes and then into the loading fixture. The loading fixture works on an indexing principle, loading one row of cavities at a time. One or more shots of material can be discharged into each row. The loading fixture is constructed with individual units for each cavity, and these can be re-arranged quickly for different numbers or spacings of cavities.

Inserts

Currently, most of the automatic molding is being done on parts that require no metal inserts to be molded in, so that only one loading device (for the material) is needed. Automation for parts requiring metal inserts is not impossible. But the quantities to be made must be large enough to justify the extra expense.

There has been some work done on automatic molding with inserts in the manufacture of automobile distributor caps. In this job the feed is preheated by high-frequency equipment. Figure 11, p. 154, illustrates the hydraulic press used. When the material loading and preheating board under the measuring and loading device *A* is filled, it will move into the high-frequency preheater *B*. Figure 12, p. 154, shows the loading board leaving the preheater and picking up the material ejec-



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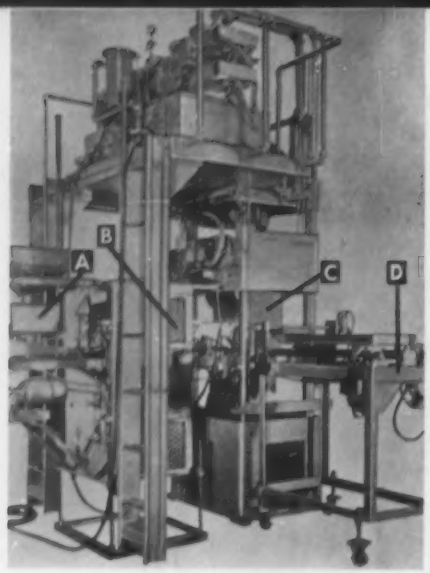


Fig. 11: Automatic compression press designed to mold inserts automatically. *A* identifies material hopper with metering and loading device below it; *B* is the high-frequency preheating unit; *C* is the mold; and *D* is the device that removes molded parts from machine. (Photo, Baker Engineering Corp.)

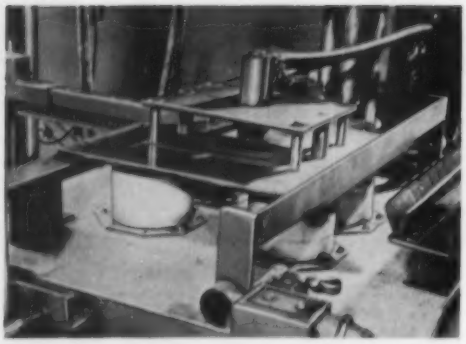


Fig. 12: Loading board of automatic press, leaving preheater. (Photo, Ford Motor Co.)

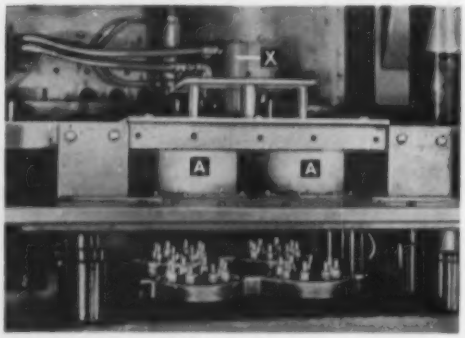


Fig. 13: Loading board reaches loading position over distributor-cap mold cavities. *X* identifies pneumatic cylinder, *A* designates Teflon tubes. (Photo, Ford Motor Co.)

Fig. 14: Finished distributor caps with automatically molded-in inserts, being ejected from mold. (Photo, Ford)

tor. The ejector is needed because the material cakes into a semi-solid mass when it is preheated above 240° F. In Fig. 13, below, the loading board is in position over the mold cavities. The tubes *A* are made of Teflon. *X* is the pneumatic cylinder that powers the material ejector. In Fig. 14, below, the distributor caps are being ejected onto the part-removing device which is at the side of the press. When this device is withdrawn, its bottom opens allowing the pieces to slide out.

On another molding job, the inserts are loaded manually with a loading board. Automatic means have been worked out and tried, and the complexity of the control circuits needed for such intricate automatic operation is vividly evident in the photo of the open control panel in Fig. 15, below.

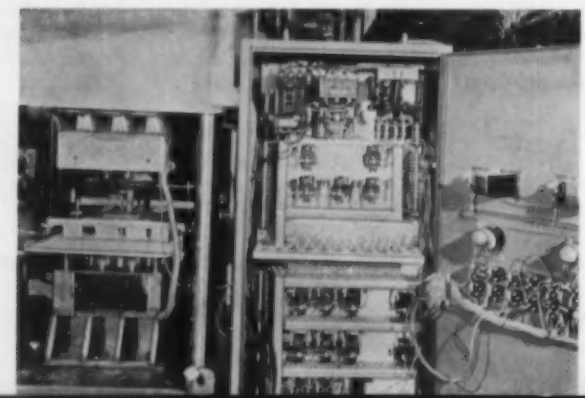
The use of high-frequency preheating of powder for automatic molding is spreading rapidly. Many plants are finding it economical to use. Coarser granulation of the material and freedom from dust are desirable. Material in the form of beads is most satisfactory for this method.

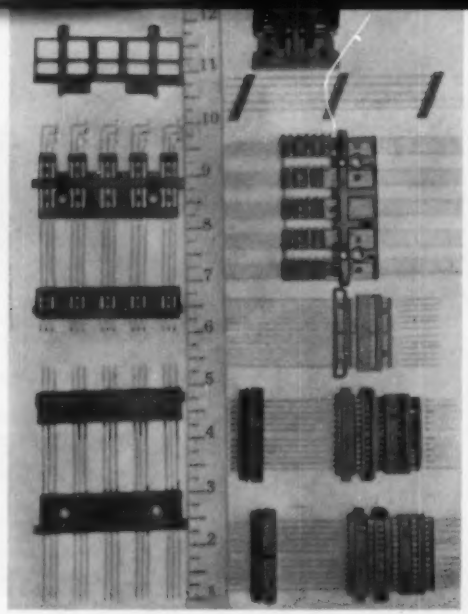
Transfer molding

Automation of transfer molding is now possible. Several types of equipment are being used. Machines designed for other jobs have been converted to automatic transfer molding. In one instance, an injection mold and molding machine were converted for transfer molding of phenolic material within 24 hours.

An interesting automatic plunger-transfer molding operation, using a vertical press, is used in making the parts illustrated in Fig. 16, p. 155. The entire cycle of feeding and preheat-

Fig. 15: Inside view of instrument panel of automatic compression press. (Photo, LaRose & Assoc.)





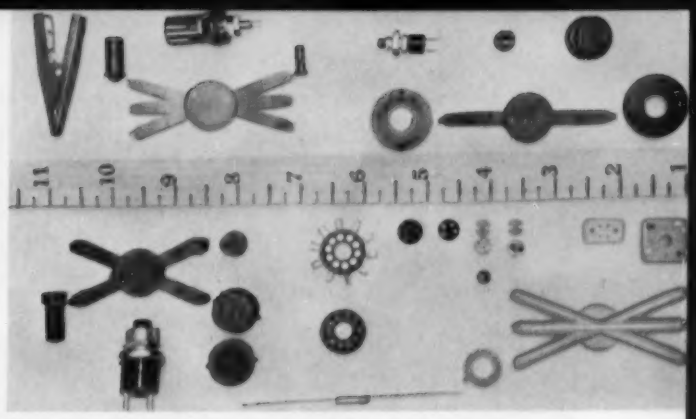


Fig. 17: Variety of tiny parts made by automatic transfer molding operation. (Photos, Grayhill Co.)

Fig. 16: Parts with molded-in wire inserts produced by automatic plunger-transfer molding process

ing of the preforms is automatic. As many as 60 continuous 19-mil wires feed four cavities simultaneously. Cutting of the wires into individual sections is accomplished when the press closes for the next shot. The "music-staff" wire in Fig. 16, located between the 10- and 11-in. ruler markings, is used in various lengths; it is molded as a continuous strip and wound on large reels.

The most completely automatic horizontal transfer molding machines were conceived and designed to make comparatively small parts for miniaturized electronic gear. The maximum area that can be molded in them is 1.25 sq. in. and the greatest depth is 0.87 inch. These machines are fed cold, loose powder.

Tiny parts molded

How small is small? Several molded parts are shown in Fig. 17, above, along with four culls and runners. Some of these parts are less than 0.25 in. in diameter and the molded holes have diameters as small as 20 mils. Feeding, shaping, and cutting of the 21-mil wire in the 10-pronged part shown in Fig. 17 between the 6- and 7-in. ruler markings is fully automatic. The work is done on an automatic transfer molding machine that is a complete, self-contained unit. It has a hydraulically operated toggle mechanism for opening and closing the mold, a part-ejection system operated from the main toggle, a hopper and loader mechanism, and a product-delivery chute with a scale mechanism for energizing the next cycle.

Figure 18, left, shows a battery of these machines in production. They often run for weeks without a single miss! The hoppers generally hold enough material for 8 hours' running; note the hopper extensions on the machines molding large-volume shots.

Since all the auxiliary equipment is built into these presses, the cost of the mold is comparatively low. Figure 19, left, shows a 4-cavity mold that was made to fit into a standard mold base, an integral part of the press. Thus for a particular molding, only the cavity inserts and the ejector assembly need be made. Very often a mold can be designed, made, and in production within a single week! Machines of this type will be available to the industry shortly. The use of high-frequency preheating is also being investigated.

Better designed and faster equipment is being made available for every method of molding. Someday, perhaps, some degree of standardization may be adopted; this will be a big step forward in reducing mold costs and increasing economy of production.

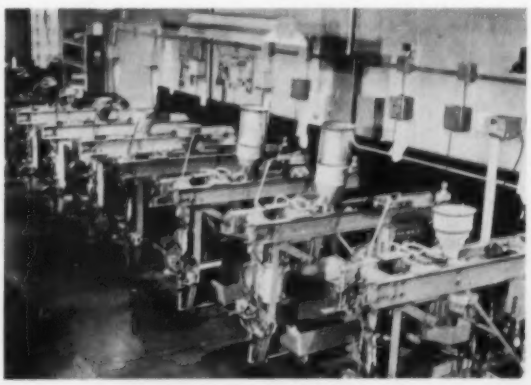


Fig. 18: Production line of automatic transfer molding machines for making small-area parts

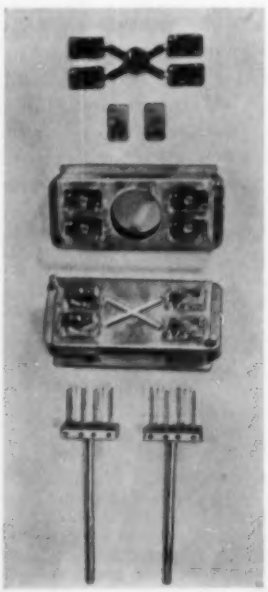
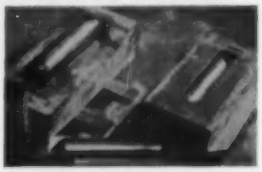


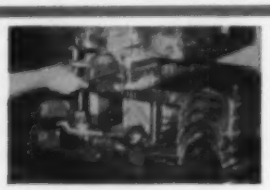
Fig. 19: Four-cavity mold, inserts, and ejection assembly for automatic transfer press, with sample molding

Cost savings of over $60,000 were achieved by a major automobile manufacturer in a single phase of prototype development of new-model cars . . . through using Marblette epoxy and phenolic resins for readily available and easily handled hammer forms and other tools and dies.

Time savings rewarded the nation's leading auto body producer through quick casting of sturdy draw dies faced with Marblette epoxy 602 laminated with fibrous glass, with cores of cold-setting epoxy 616. This tool determined a complicated part's die design.



Delays are minimized as Glennie Industries (Romulus, Mich.) finds draw dies like these suitable for production runs of up to 20,000 panels. For additional runs, plastic dies can be renewed in 48 hours by simple refacing.



Design changes in production pieces are easily incorporated in any of these epoxy tools, by chipping back and recasting any area of the die.

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Plastics Technical Section

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Weathering of plastics

A method of studying the resistance of plastics to outdoor exposure

By J. J. Gouza† *and W. F. Bartoe*†

A convenient procedure for studying the surface deterioration, crazing, and creep deformation of plastics subjected to stress during outdoor exposure is described. Considerations of critical creep strain, threshold crazing stress, permanent set, and predicted service life are discussed. Data are cited to show the possibility of failure of test results obtained in laboratory atmospheres to predict outdoor service characteristics.

Considerable knowledge of the weathering resistance of clear plastics has been obtained by many independent industrial and governmental studies (1-3).[1] Our company has placed on exposure thousands of plastic specimens yearly, until we now have approximately 50,000 samples on outdoor exposure at Bristol, Pa.; Miami, Fla.; and Phoenix, Ariz. Most of these specimens are exposed for observation of color and surface quality changes. Such changes are judged visually in the manner usually employed in evaluating coatings. Light transmission, haze, and surface hardness changes are measured. In a few cases panels or specimens are exposed for use in determining changes in strength properties brought about as the result of weathering influences.

The behavior of plastics under stress has been investigated by various individuals (4-10). Unfortunately many of the materials that appear promising in the laboratory deteriorate rapidly on outdoor exposure. Since stress is frequently associated with plastic parts used outdoors, our attention has been directed toward studying their behavior under applied stress when subjected to various climatic conditions. This paper is concerned with a study undertaken to determine the craze and rupture behavior of rigid transparent plastics subjected to constant loads and exposed to the weather at Bristol, Pa.

This article is based on a paper presented at the 1955 Annual S.P.E. Conference.
*Reg. U. S. Pat. Off.
†Rohm & Haas Co.
[1]Numbers in parentheses link to references at end of article, p. 245.

Nomenclature

The following terms apply to the observations reported herein.

Crazing is the term used to describe the presence of small local fractures, usually on the surface of a material (Fig. 1).

Stress-crazing is surface crazing in which the fissures or cracks are oriented in accordance with applied stresses (Fig. 2). In this type of crazing, each craze mark is perpendicular to the tensile stress at that point.

Threshold crazing stress is the minimum stress at which crazing is oberved on a specimen. It is obtained by measuring the extent of crazing and determining the lowest stress as it occurs.

Critical creep strain for crazing

Fig. 1: Unoriented crazing

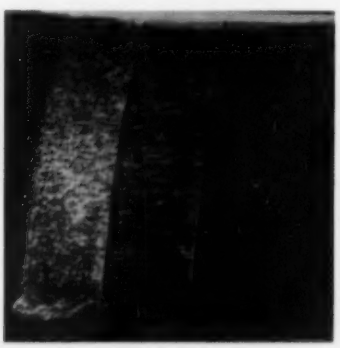

Fig. 2: Oriented crazing

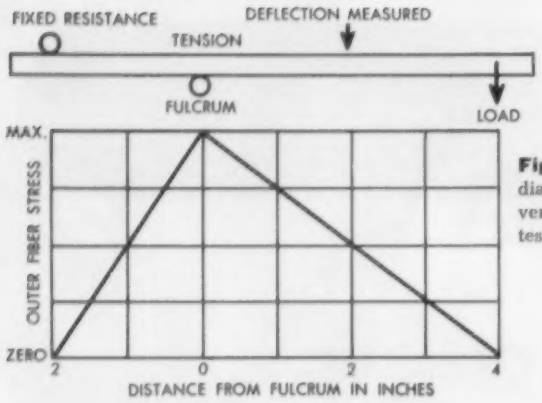

Fig. 3: Schematic diagram of cantilever-mounted plastic test specimen

is the time-dependent strain that occurs before crazing appears. It is the total strain at the instant crazing appears minus the instantaneous elastic strain. The critical creep strain for crazing has been shown to be independent of both temperature and applied stress for methyl methacrylate (11, 12).

Creep is a continuing deformation under load.

Permanent set is the deformation that remains in a specimen upon the removal of the load applied in the creep test.

Test method

Equipment: The cantilever flexural beam (Fig. 3, above) was selected to apply the stress since it affords the maximum exposure to the elements of the "as-manufactured" surface, facilitates the observation of crazing, and in many cases simulates actual end use.

The test jigs are rigid, vibration-free racks supporting two ¼-in. diameter stainless steel rods horizontally and parallel with a 2-in. spacing. The axis of the upper, rear rod is ¼ in. above the axis of the front. These rods form the load-bearing fulcrums for the test specimen. Sheet metal cabinets with removable front panels enclose the bottom of the racks to protect the applied lead weight loads from the wind, thereby preventing their swaying. The test jigs are mounted in such a way that they face south.

A dial indicator with 2 in. of travel, attached to a frame which indexes its position reproducibly from the fulcrum rods, is used to measure the deflection of the specimen. We call this a beam deflectometer.

A flashlight lamp on a gooseneck tube is used to supply the illumination for examining the specimens.

A 6-in. stainless steel scale, attached to a U-shaped yoke which indexes it with respect to the forward fulcrum, is provided for measuring the extent of crazing on the test specimen.

A 35-mm. camera, attached to an indexing frame and equipped with a built-in light source, is provided for obtaining permanent records of the appearance of the crazing marks.

Rods, threaded to receive a V-surfaced nut for load application on one end and a pan to hold lead weights on the other, are used for applying the stressing loads. Weights are punched from lead sheet of various thicknesses to permit their being piled-up to the desired value.

Specimen preparation: A material cannot be tested without also testing the method of preparation of that material. This is particularly true of plastics. Therefore, to obtain uniformity of test results and confidence therein, great care must be taken in the preparation, treatment, and handling of the test specimens. Since the "as-manufactured" surface of the plastic is usually the one to be tested, this surface is protected with masking paper during the various preparatory operations.

The plastic is sawed into 1- by 7-in. test specimens. The edges of the specimen are freed of all saw marks, chipped edges, and other irregularities by shaping or drawfiling parallel to the long axis of the specimen. Each specimen is placed in a drilling jig and a ¼-in.-diameter hole is drilled ½ in. from one end and on the longitudinal centerline of the specimen. The specimen is turned over and the drilled hole is countersunk to the opposite surface. This countersink is made in the bottom surface of the specimen to allow the weight application rods to hang freely during the course of the test while the specimen is deflecting. The specimen is then placed in a marking jig and a pencil line drawn up the side of the specimen at 4 in. from the center of the ¼-in.-diameter hole. The masking paper is removed from both surfaces of the specimen and henceforth the specimen is only handled by its edges. Usually the test specimens are not cleaned in any other manner. Before testing, all transparent specimens are given a polariscopic inspection; those which show concentrated strain

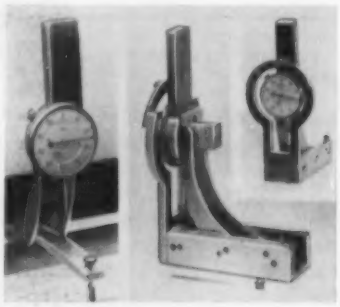

Fig. 4: Deflection gages

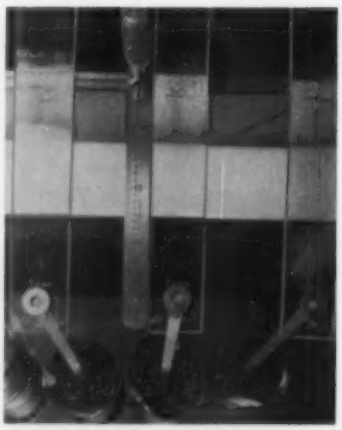

Fig. 5: Gage used to measure extent of crazing

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Table I: Craze resistance of methacrylate-base polymers[a]

Material		Craze time at indicated outer fiber stress — 2000 p.s.i.	3000 p.s.i.	4000 p.s.i.
		days	days	days
Plexiglas I-A	Average	212	109	15
	Range	182-238	63-154	1-22
Plexiglas II	Average	307	185	61
	Range	238-581	84-238	35-126
UVA Plexiglas II	Average	>526	199	94
	Range	273->1026	154-252	49-147
Plexiglas 55	Average	>848	376	326
	Range	574->1026	273-833	238-518

[a]Long-time cantilever flexure tests on outdoor exposure at Bristol, Pa., starting Nov. 15, 1951; 12 specimens tested under each condition.

Table II: Rupture resistance of methacrylate-base polymers[a]

Material		Rupture time at indicated outer fiber stress — 2000 p.s.i.	3000 p.s.i.	4000 p.s.i.
		days	days	days
Plexiglas I-A	Average	616	233	92
	Range	412-903	154-315	43-112
Plexiglas II	Average	>979	424	130
	Range	889->1026	322-476	105-154
UVA Plexiglas II	Average	>1026	>780	190
	Range	None	539->1026	140-308
Plexiglas 55	Average	>1026	738	458
	Range	None	490-917	322-539

[a]Long-time cantilever flexure tests on outdoor exposure at Bristol, Pa., starting Nov. 15, 1951; 12 specimens tested under each condition.

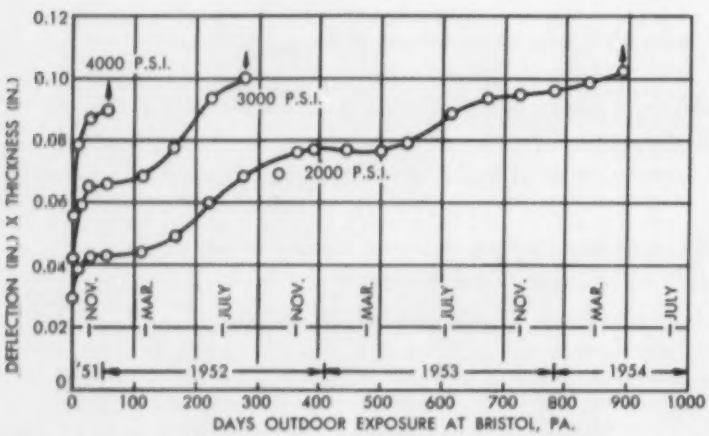

Fig. 6: Creep in long-time cantilever flexure test of Plexiglas I-A exposed to weather at Bristol, Pa., on November 1951

patterns are rejected unless these effects are being studied.

The width and thickness of the specimen is measured to the nearest 0.001 in. at the pencil line. The load required to produce the desired stress is computed by the following formula:

$$P = \frac{SBD^2}{6L}$$

where P = load in pounds, S = maximum fiber stress in p.s.i., L = length of specimen from fulcrum to center of applied load in inches, B = width of specimen in inches, and D = thickness of specimen in inches. For our jigs and standard test specimen this reduces to:

$$P = \frac{SBD^2}{24}.$$

To facilitate calculation of the load, nomographs and special slide rules have been constructed.

The formula for calculating loads is re-arranged as follows for calculating the threshold crazing stress:

$$TC = \frac{6PL_c}{BD^2}$$

where TC = threshold crazing stress in p.s.i., P = load in pounds, L_c = distance from centerline of applied load to first point of center crazing in inches, B = width of specimen in inches, and D = thickness of specimen in inches. For our jigs and standard test specimen, L_c = 4 in. minus distance in inches of extent of crazing from the fulcrum.

The load, computed to the nearest 0.01 lb., is assembled from the lead weights on the loading rods and checked by actual weighing on a beam balance. The test specimen is placed on the loading rod and the V-surfaced nut applied.

All specimen identification and stress data are recorded on printed forms, which provide spaces for subsequent insertion of beam deflection data and crazing observations.

Test procedure: After transfer to exposure station, the test specimen is removed from the loading rod, the rod set below it on the ground, and the specimen inserted in position in the test jig with the pencil mark in line with the center of the fulcrum. The beam deflectometer (Fig. 4, p. 158) is placed over the specimen and the original position of the specimen recorded. The end of the rod-weight assembly is inserted through the hole in the specimen and the load-supporting, beveled nut screwed on the rod and aligned parallel to the fulcrum. The load is slowly applied and the deflection of the

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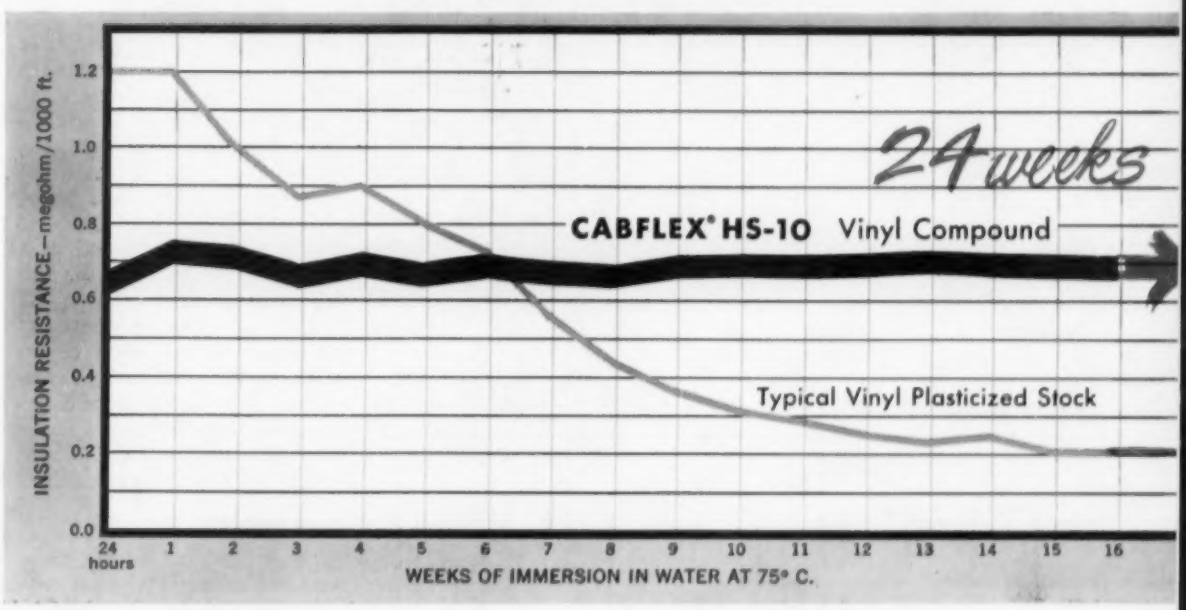

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loaded specimen is read immediately and periodically thereafter.

Since the deflections of a cantilever beam are relatively large, measurement by a dial gage graduated in thousandths of an inch is quite precise. The spring that is attached to the plunger is removed to eliminate this force, which may be sufficient to alter the deflection of a lightly loaded or a highly flexible specimen.

Table III: Critical creep strain for crazing of methacrylate-base polymers[a]

Material	Critical creep strain (deflection × thickness) at indicated outer fiber stress		
	2000 p.s.i.	3000 p.s.i.	4000 p.s.i.
	in.²	in.²	in.²
Plexiglas I-A	0.027	0.026	0.023
Plexiglas II	0.024	0.029	0.031
UVA Plexiglas II	>0.022	0.028	0.028
Plexiglas 55	>0.045	0.063	0.084

[a]Long-time cantilever flexure tests on outdoor exposure at Bristol, Pa., starting Nov. 15, 1951; 12 specimens tested under each condition.

Table IV: Comparison of the craze resistance of plastics[a]

Material		Craze time at indicated outer fiber stress			
		3000 p.s.i.	4000 p.s.i.	5000 p.s.i.	6000 p.s.i.
		days	days	days	days
Heat-resistant acrylic	Average	148	85	37	5
	Range	105-238	64-98	23-70	2-11
Heat- and craze-resistant acrylic	Average	371	146	103	74
	Range	154-518	112-238	84-133	42-91
Modified acrylic	Average	>568	>568	>568	>568
	Range	None	None	None	None
Polyester	Average	193	109	14	6
	Range	154-238	98-112	7-24	6-7

[a]Long-time cantilever flexure tests on outdoor exposure at Bristol, Pa., starting Feb. 18, 1951; six specimens tested under each condition.

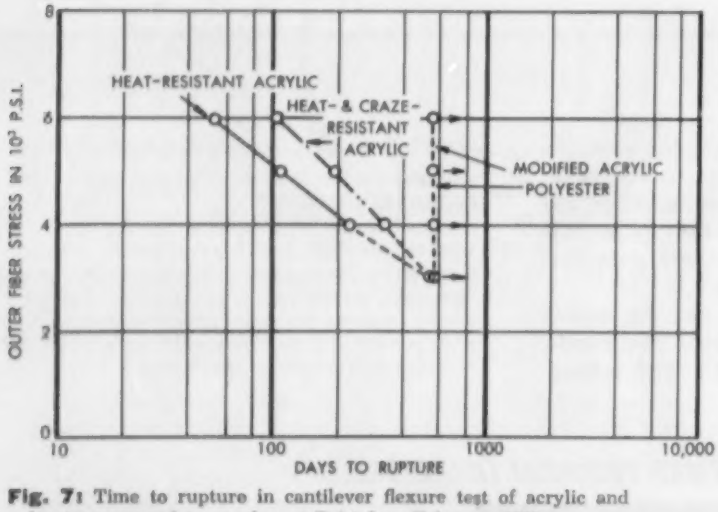

Fig. 7: Time to rupture in cantilever flexure test of acrylic and polyesters exposed to weather at Bristol on February 1951

The operator then covers himself and part of the jig with an opaque, black cloth hood. Using the special flashlight, he then examines the specimen for crazing. Trained personnel is indispensible for efficiently detecting crazing marks. Only in referee cases is a magnifying glass used in making the inspection. The extent of the crazing from the fulcrum is measured to the nearest ⅛ inch. This measurement is used in computing the threshold crazing stress through the formula previously given.

The test specimen is inspected for deflection immediately after loading and for deflection, crazing, extent of crazing (Fig. 5, p. 158), and rupture after 15 min. (approximately 0.01 day), 2½ hr. (approximately 0.1 day), daily for 28 days, and weekly thereafter. The time for the appearance of the first craze mark on each specimen is considered the first end point. Rupture is considered the second end point. The permanent set of an unbroken specimen is determined by removing the load and recording the immediate recovery of deflection with the beam deflectometer. The recovery is measured periodically thereafter until the rate approaches zero.

In the examination of crazing, all cracks at the edges of the specimen are noted as *edge crazing* and disregarded in the determination of the end point unless they grow and extend across the entire width of the specimen.

Data analysis

The analysis of outdoor exposure test data on plastics is made difficult by the random nature of the observed failures. This is particularly true of surface deterioration failures, of which crazing is one type. The scatter of data is inherent in the material and slightly amplified by the discontinuous nature of the observation schedule. Replication of test specimens is of some help in establishing average values and data ranges to assist in final analysis. A typical set of observations is listed in Tables I and II, p. 160.

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(*To page* 244)

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Improved ester-plasticized polyvinyl chlorides

By W. F. Fischer and B. M. Vanderbilt**

Stabilization of plasticized polyvinyl chloride resins has been studied in the past primarily from the standpoint of resin breakdown. The present study is directed towards the use of an antioxidant to improve the stability of the ester plasticizer.

Esters of Oxo alcohols were employed as plasticizers. Bisphenol-A was highly effective as an antioxidant, and because of its availability and cost, it was emphasized in this study. Based on oxygen-aging and oven-aging studies at 212° F., use of bisphenol-A in as low as 0.02 part per 100 parts of resin gave greatly improved physical and color stability. The usual commercial stabilizers for the polyvinyl chloride were also employed. Analytical procedures for the determination of bisphenol-A in plasticized resins are suggested.

It is concluded that the use of bisphenol-A in plasticized vinyl formulations results in products of excellent aging characteristics.

It has been firmly established that all polyvinyl chloride resin formulations require stabilization against the deleterious effects of heat, oxygen, and light, all of which are normally encountered during processing and on aging of the resulting plastic product. Degradation of vinyl chloride polymers and copolymers apparently occurs through the dual mechanism of dehydrochlorination and oxidation.

Early work by Marvel (1)[1] and associates indicated that discoloration of degraded polyvinyl chloride (PVC) arises from a polyene structure of the type $(-CH=CH-)_n$. Boyer (2) found that oxygen was present in degraded PVC in the form of carbonyl groups. Later studies by Druesedow and Gibbs (3) indicated that evolution of HCl from thermally decomposed vinyl resin approaches a steady-state condition in a nitrogen atmosphere, but that the reaction becomes autocatalytic in the presence of oxygen. These studies establish the structure of degraded PVC and suggest the important role that oxygen plays.

Plasticized PVC systems in the past have been studied primarily from the viewpoint of developing new stabilizers for the resin. Materials that primarily function as HCl acceptors include epoxy compounds and various salts of lead, tin, cadmium, strontium, barium, calcium, and zinc. Tomka (4) discusses the behavior of different classes of resin stabilizers in a recent publication. Fox *et al.* (5) in their excellent publication acknowledged the contributing effect of plasticizers on the ultimate heat and light resistance of PVC as important but secondary. They suggested that an ideally stabilized system would include an antioxidant capable of inhibiting carbonyl formation within the polymer. Mention of possible antioxidant action is found in Mack's (6) review of stabilizer action in his discussion of tin stabilizers and chelating compounds. Scarborough *et al.* (7) indicate that for an antioxidant to be a good light stabilizer for PVC it must be to some extent an acid acceptor or used with an acid acceptor. Despite the recognition that oxygen may play an important role in the degradation of straight PVC and plasticized PVC systems, there is no literature available on stabilizers that would function mainly as antioxygen compounds.

Our approach to the improvement of plasticized PVC has been the use of an inhibitor directed primarily to the improvement of the stability of the ester plasticizer. Esters, like all other organic materials, are susceptible to molecular breakdown by oxygen or air. Esters as synthetic lubricants represent an application at relatively high temperatures, and Murphy *et al.* (8, 9) have shown certain inhibitors to be effective in preventing this oxidative breakdown. We have found that esters undergo some oxidative breakdown under conditions met in the fabrication and application of PVC plastics, and that inhibitors of the antioxidant type are highly effective in counteracting such degradation.

Materials tested

Phthalates of isooctyl and decyl alcohols manufactured by the Oxo process have found wide acceptance as vinyl plasticizers in the period since the Oxo alcohols were first introduced commercially in this country by Enjay Co. in 1948. Esters of Oxo alcohols were employed as the plasticizers in this study. The Oxo process involves the oxonation of an olefin feed with carbon monoxide and hydrogen in the presence of a cobalt catalyst. The aldehydes so formed are hydrogenated to form the so-called Oxo alcohols.

Inhibitors tested were largely

*Enjay Laboratories, Esso Research and Engineering Co.

[1]Numbers in parentheses link to references at end of article, p. 172.

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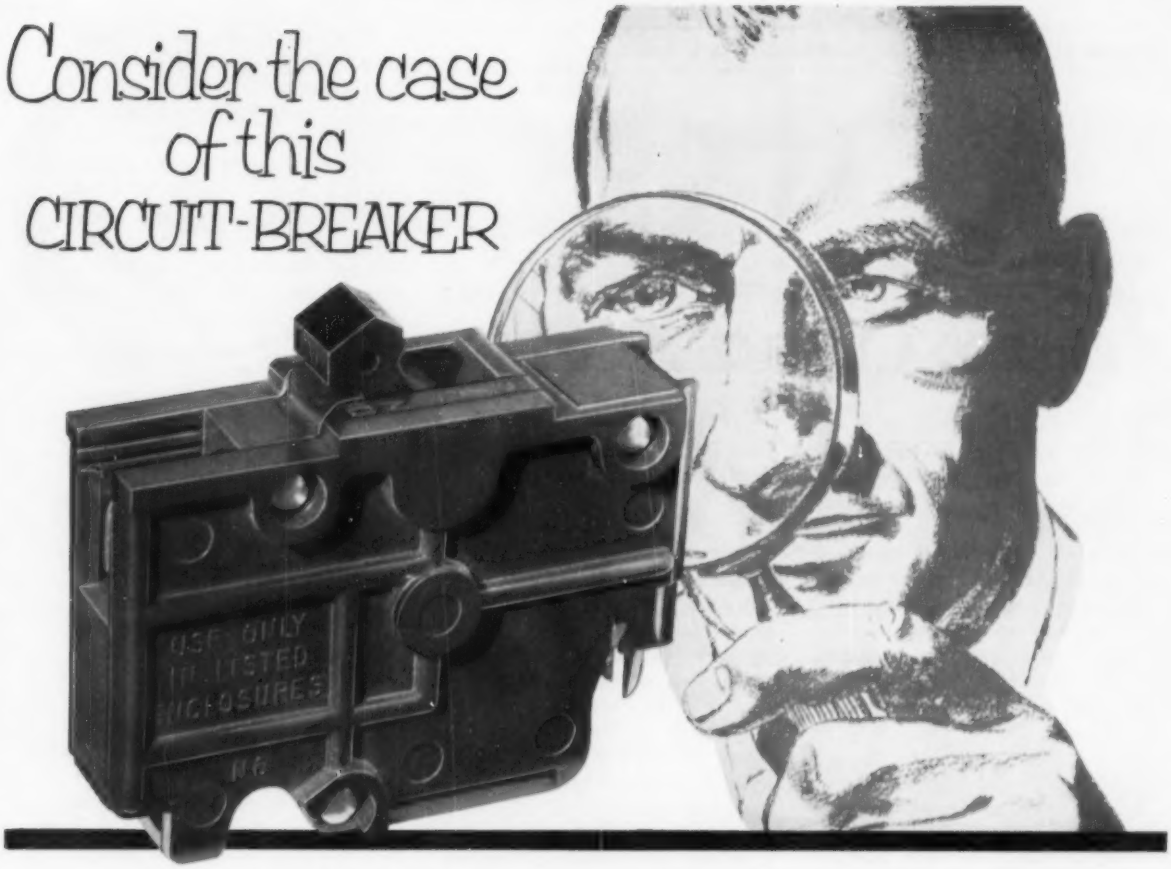

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Table I: Effectiveness of bisphenol-A as a stabilizer

Material	Amount of bisphenol-A	Peroxide content	
		Original	Oxidized
	p.p.h.[a]	p.p.m.[b]	p.p.m.[b]
Isooctyl alcohol	None	16	940[c]
Isooctyl alcohol	0.25	16	18
Diisooctyl phthalate	None	14	144
Diisooctyl phthalate	0.25	14	14

[a] p.p.h. = parts per hundred.
[b] p.p.m. = parts per million.
[c] Oxygen pressure fell 24 p.s.i. during the test as compared to 7 p.s.i. for the stabilized sample.

of the phenolic type. The aromatic amines, such as phenyl beta-naphthylamine, which find wide usage in rubbers, are not applicable in PVC because of discoloration imparted to the unaged film. For this same reason stabilizers of the aldehyde-amine type, the substituted hydroquinones and morpholines, plus a variety of other miscellaneous types were rejected as unsuitable. Phenol and alkylated phenols were found to be too volatile to be of interest as stabilizers due to losses on use, particularly when the PVC is used in film form. The bisphenols, as a class, are quite effective (10). The following class of bisphenols proved to be of particular interest:

where R and R' are alkyl groups.

Bisphenol-A (also called diphenylolpropane,2,2 - bis(4 - hydroxyphenyl) propane, and 4,4'-isopropylidene diphenol), where R and R' are methyl groups, is the simplest of the bisphenols of this type. Since it is available on the market at relatively low cost, its use as a stabilizer for Oxo alcohol ester plasticizers was emphasized. Bis-type inhibitors having substituted groups on the aromatic ring generally tend to impart higher color to unaged plasticized vinyl resin film.

Oxygen aging

The effectiveness of bisphenol-A as a stabilizer for both isooctyl alcohol and diisooctyl phthalate (DIOP) is illustrated by the data in Table I, above (11). Samples of each were placed under 125 p.s.i.g. of oxygen at 212° F. and allowed to stand for 24 hours.

It is well known that peroxides and hydroperoxides may be the initial oxidation products in the non-catalytic oxidation of organic liquids. Such oxidation products are the precursors of aldehydes, ketones, etc., which lead to sludge and discoloration.

Work by Baldwin (12) accurately defines the relative resistance to oxidation of non-inhibited and inhibited DIOP vinyl compositions. Data shown in Fig. 1, below, were obtained using an oxidation apparatus specially designed for constant pressure and constant temperature. The test procedure consists of dicing a weighed amount of 0.0001 in. thick vinyl film into approximately ⅛-in. squares, and exposing them to oxygen. It is evident that bisphenol-A successfully prolongs the induction period of a DIOP-vinyl composition from essentially zero time to 70 hours. Thereafter, oxidation proceeds at approximately the same rate as it would have if the inhibitor had not been present. How the inhibitor has been consumed or rendered ineffective has not been established. Within the limitations of the method any differences in oxidation stability due to different structures of the ester plasticizers may be overcome through the use of the antioxidant. This is shown by comparing bisphenol-A stabilized DIOP with uninhibited di-n-octyl phthalate.

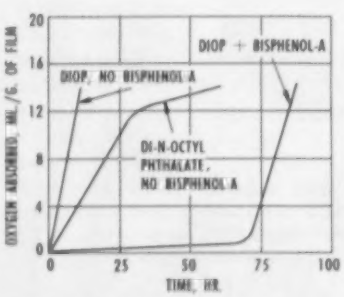

Fig. 1: Oxidation rate measurements at 124° C. on uninhibited *versus* bisphenol-A-stabilized PVC films. *Formulation* (parts): PVC — 100; Vanstay — 2; lead stearate — 1; plasticizer —50; bisphenol-A (where indicated) —0.05

Oven aging

Degradation of plasticized vinyl compounds during hot-air aging may be attributed to the combined effects of three interrelated phenomena. These are cross-linking between polymer chains, volatilization of the plasticizer, and destruction of the plasticizer by oxidative attack. The criteria used for measuring the net effect of these degradative processes were loss of elongation and tensile strength, increase in modulus, and color change of the test specimens. Decrease in elongation is considered the most critical measurement.

The test samples were prepared by mixing 100 parts of PVC, 50 parts of plasticizer (which may or may not contain bisphenol-A), and 3 parts of commercial stabilizer on an 8- by 16-in. mill for 5 min. at 300° F. Sheets were calendered for molding into 6- by 6-in. test slabs. The molding procedure consisted of pressing the sheets in a mold at high pressure for 7 min. at 320° F. and cooling the slab in the mold under pressure. Tensile, modulus, and elongation properties were determined on specimens 0.075 in. thick. Heat stability was determined in a modified forced-draft air oven. In this special oven it was possible to evaluate 16 different compounds at the same time under conditions where temperature, air direction, and velocity of 400 ft./min. were rigidly controlled and contamination minimized.

Data shown in Table II, p. 168, indicate that very effective sta-

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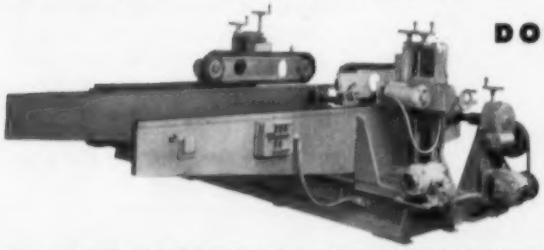

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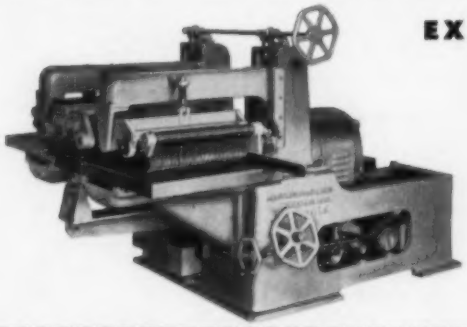

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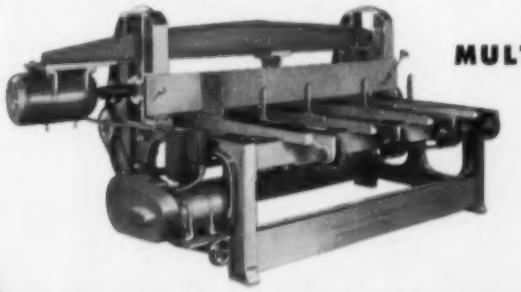

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bilization is obtained using a bisphenol-A-barium-cadmium system. Stress-strain properties, plotted in Fig. 2, below, remain at a very high level and color retention is excellent. The interesting beneficial effect of the antioxidant is shown by comparison of the samples with and without bisphenol-A. The inclusion of as little as 0.05 part of this antioxidant results in a marked improvement in retention of the original elongation after aging at 212° F. for 14 days.

Despite slight discrepancies in test results, it is evident from the higher elongation and better color retained after aging, that the antioxidant effectively stabilized the DIOP-vinyl composition. The smaller increase in modulus of the aged DDP stock as compared to the DIOP-plasticized material, can be attributed to the higher molecular weight and lower volatility of didecyl phthalate.

Sufficient work has been done on combinations of resin stabilizers to indicate generally that bisphenol-A improves their effectiveness in stabilizing vinyl compositions. The three PVC stabilizer systems studied with bisphenol-A are believed to be typical. Studies of the antioxidant with individual and combinations of stabilizers, however, represent only a few of well over a hundred resin stabilizers commercially available to the trade.

Table II: Heat stability evaluation of polyvinyl chloride compositions

Formulation (parts)

Polyvinyl chloride	100	Barium ricinoleate	1
Plasticizer	50	Cadmium naphthenate	2

Plasticizer	*DIOP*[a]	*DIOP*[a]	*DDP*[b]
Bisphenol-A, p.h.r.[c]	*0*	*0.05*	*0.05*
Original			
Tensile, p.s.i.	2820	2710	2490
Modulus, 100%, p.s.i.	1560	1670	1730
Elongation, %	320	300	270
Color	Colorless; transparent	Colorless; transparent	Colorless; transparent
Aged 7 days at 212° F.			
Tensile, p.s.i.	2430	2700	2650
Modulus, 100%, p.s.i.	1560	1550	1680
Elongation, %	250	280	300
Elongation retained, %	78	93	100
Aged 14 days at 212° F.			
Tensile, p.s.i.	2540	2850	2630
Modulus, 100%, p.s.i.	2145	2220	1860
Elongation, %	195	260	270
Elongation retained, %	61	87	100
Color	Red-brown with opaque spots	Very slightly yellow; transparent	Very slightly yellow; transparent

[a] Diisooctyl phthalate.
[b] Didecyl phthalate.
[c] Parts per hundred of resin.

Table III: Stabilizing effects of bisphenol-A in PVC electrical insulation

Formulation (parts)

Polyvinyl chloride	100	Tribase	5
Plasticizer	37	Stearic acid	0.25
M33 Clay	35		

Plasticizer	*DIOP*[a]	*DIOP*[a]	*Isooctyl decyl phthalate*	*DDP*[b]
Bisphenol-A, p.h.r.[c]	*0*	*0.05*	*0.05*	*0.05*
Original				
Tensile, p.s.i.	2315	2435	2445	2360
Elongation, %	220	240	230	230
Color	Light tan; opaque			
Aged 4 days at 212° F.				
Tensile, p.s.i.	2250	2470	2505	2365
Elongation, %	200	220	215	220
Elongation retained, %	91	92	93	96
Aged 10 days at 212° F.				
Tensile, p.s.i.	2145	2460	2505	2355
Elongation, %	125	205	215	225
Elongation retained, %	57	86	93	98
Color	Red-brown; opaque	Light tan; opaque		

[a] Diisooctyl phthalate.
[b] Didecyl phthalate.
[c] Parts per hundred of resin.

Electrical insulation

The beneficial effect of bisphenol-A is of particular interest in the formulation of vinyl insulation where Underwriters' specifications require high quality heat and electrical stability. The data in Table III, left, show the stabilizing effect of bisphe-

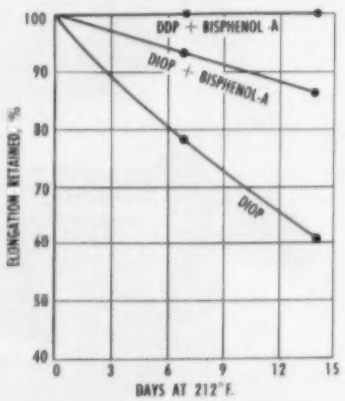

Fig. 2: Retention of elongation after heat-aging of PVC compositions. *Formulation* (parts): PVC — 100; plasticizer — 50; barium ricinoleate — 1; cadmium naphthenate — 2; bisphenol-A (where indicated) — 0.05

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Table IV: Stabilization by bisphenol-A of PVC plasticized with diisooctyl adipate

Formulation (parts)

Polyvinyl chloride 100, Diisooctyl adipate 50, Lead stearate 1

Bisphenol-A, p.h.r.[b]	*None*	*0.25*	*0.25*
Vanstay 16, p.h.r	*2*	*2*	*None*
Original			
Tensile, p.s.i.	2610	2700	2730
Modulus, 100%, p.s.i.	1420	1480	1400
Elongation, %	300	290	305
Aged 5 days at 212° F.[a]			
Tensile, p.s.i.	2330	2790	2980
Modulus, 100%, p.s.i.	2240	2150	2210
Elongation, %	115	245	305
Elongation retained, %	38	84	100

[a]Only the formulation not containing bisphenol-A suffered from color degradation while exposed to these aging conditions.
[b]Parts per hundred of resin.

nol-A in an electrical formulation. Lead-type resin stabilizers are normally used for this application. Excellent heat stability of the inhibited electrical compounds is demonstrated by the high retention of elongation and tensile properties after aging.

The effect of the small concentration of antioxidant on electrical properties of the vinyl compound has not been thoroughly evaluated. However, the following insulation resistance data obtained for dry test pads show that bisphenol-A does not contribute any deleterious effects.

Plasticizer	*D. C. resistivity at 25° C.*
	10^{11} ohm-cm.
Isooctyl decyl phthalate, unstabilized	8.9
Isooctyl decyl phthalate, (0.05 part bisphenol-A)	11.4

Actually, the slightly higher value determined on the inhibited compound may be attributed to better protection of the mix against oxidative degradation during all phases of the 300° F. mill-mixing cycle. Theoretically, protection against the formation of oxygen-containing degradation products should have a favorable effect on electrical properties, particularly under humid conditions.

Stabilization of other esters

Bisphenol-A is effective for stabilizing all esters regardless of alcohol or acid types. Phosphate, azelate, adipate, and sebacate esters of isooctyl alcohol were similarly improved when containing about 0.25% of bisphenol-A. The data in Table IV, above, for diisooctyl adipate are typical of the improvements obtained.

Light aging

While the substantial degree of improvement in heat resistance of plasticized PVC compositions containing bisphenol-A has been demonstrated, its effect on light resistance has not been firmly established. Within the scope of our work, no deleterious effects were observed. Results range from very favorable retention of film clarity in the Fadeometer to no apparent effect in films exposed outdoors for 2 years.

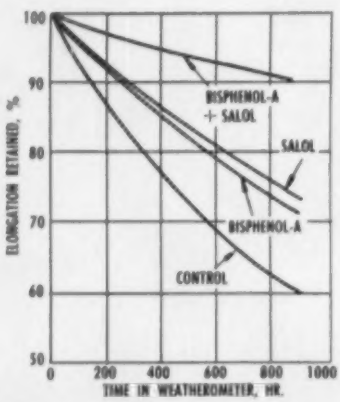


Fig. 3: Retention of elongation after light-aging of PVC compositions. *Formulation* (parts): PVC — 100; plasticizer (DIOP) — 50; Vanstay — 2; DB lead stearate — 1; bisphenol-A (where indicated) — 0.05; Salol (where indicated) — 1

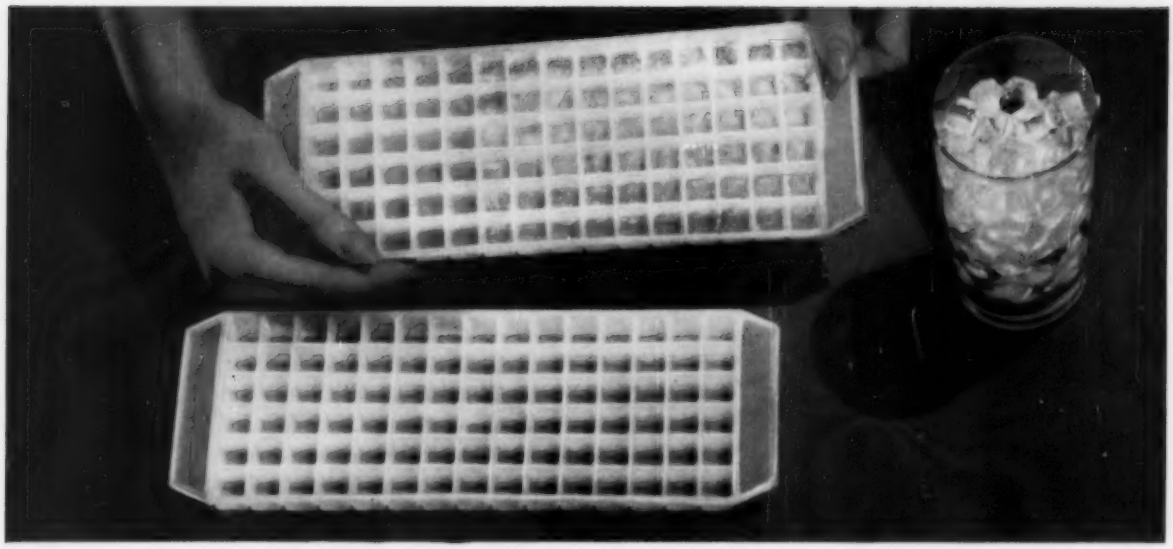
Carruthers and Blair (13) have patented the use of phenyl salicylate as a light inhibitor for PVC resins. As indicated in Fig. 3, a combination of bisphenol-A and phenyl salicylate (Salol) shows better retention of elongation on artificial light aging than either compound when used alone or compared to the control compound. After exposure all compounds were colorless, translucent, and showed no surface defects except the control. It had become white-opaque in appearance with some brown spots. The bisphenol - A - Salol stabilizer combination enhanced the heat resistance of vinyl compositions to the same degree as indicated in previous data for bisphenol-A alone, thereby demonstrating that Salol does not reduce the bisphenol-A efficiency.

Antioxidant concentration

The effect of bisphenol-A concentration is shown in Fig. 4, p. 172, for a formulation containing Vanstay and lead stearate. Results with this system are good; stabilization is obtained with as little as 0.02 part of bisphenol-A. Within the limits of these tests, no additive concentration effect of bisphenol-A is noted. Where severe heat aging conditions are encountered, however, plasticized vinyl systems containing higher concentrations of inhibitor would be expected to give better protection. The practical working range of bisphenol-A, as determined by a balance between performance and solubility, is approximately from 0.05 to 0.25 part per hundred parts of vinyl polymer.

Bisphenol-A analysis

Based on preliminary data, bisphenol-A in Oxo alcohol phthalates can be determined by infrared spectroscopy and chemical colorimetric analysis. Absorption occurs at 6.53 microns. This corresponds to a narrow absorption band observed by Barnes (14) for para-substituted aromatics. Extraction of the bisphenol-A to give a more concentrated solution may be necessary because of the



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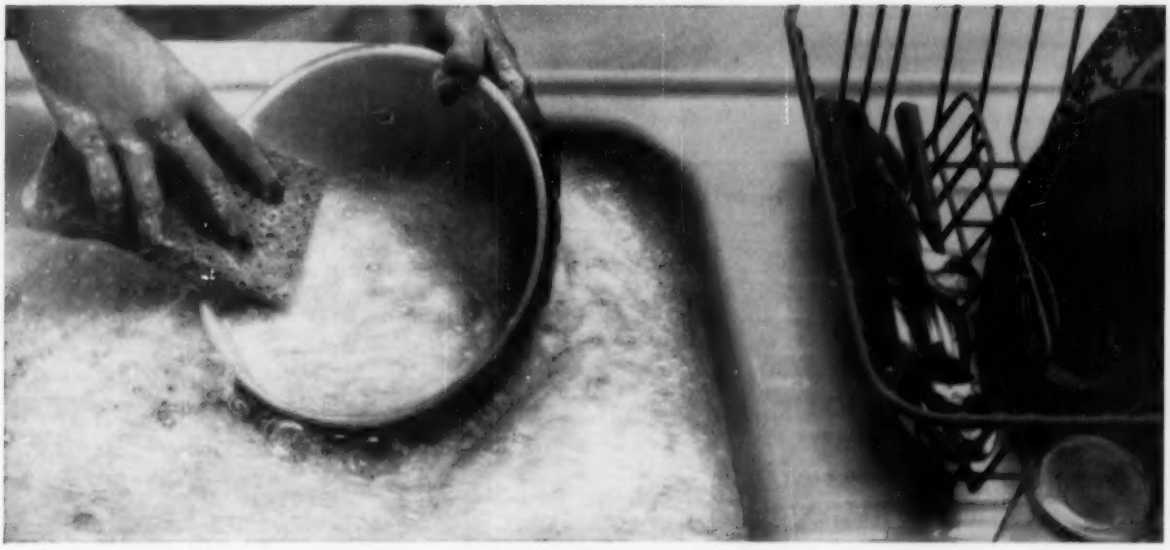

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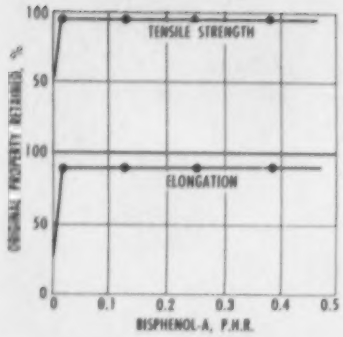

Fig. 4: Effect of bisphenol-A concentration on stabilization of PVC compositions (samples aged seven days at 212° F.) *Formulation* (parts): PVC — 100; plasticizer (DIOP) — 50; Vanstay—2; lead stearate —1; bisphenol-A — varying, as indicated on graph

small concentration of stabilizer in the plasticizer.

A calibration curve, Fig. 5, is prepared by plotting baseline absorbance against the stabilizer concentration. These absorbances are obtained by measuring the baseline absorbance between the peak absorbance at 6.53 microns and the baseline extending from 6.0 to 10.2 microns. The analytical procedure consists of determining the baseline absorbance for the sample and reading the inhibitor concentration directly from the calibration curve.

Enough work has been done on a chemical method of analysis for bisphenol-A in esters to show that a quick practical method can be developed. The test is a modified Lykken *et al.* (15) method based on nitration of the aromatic ring of the stabilizer to give yellow colors. The color intensity developed is proportional to the degree of nitration. Reagents required are as follows: glacial acetic acid, concentrated sulfuric acid, saturated sodium nitrite, and alcoholic ammonium hydroxide.

The procedure consists of adding 5 ml. of acetic acid to 2 ml. of the stabilized ester in a 50-ml. test tube. Six drops of concentrated sulfuric acid and three drops of saturated sodium nitrite solution are added. Swirl gently, allow the mixture to stand for 30 min., and then slowly add about 30 ml. of alcoholic ammonium hydroxide solution while cooling the container in an ice bath. After 1 hr. read the color intensity on a colorimeter at 420 mμ using a 5-ml. cell. Using the measured color intensity value, the concentration of stabilizer is read from a previously prepared calibration curve based on known stabilizer contents in the ester. This method is sensitive to bisphenol-A contents as low as 0.02 percent. A minor emulsion problem must be overcome and reaction times and temperature standardized.

Adding bisphenol to ester

Bisphenol-A is soluble in most oxygenated solvents as indicated below:

Solvents	*Non-solvents*
Acetone	Carbon tetrachloride
Cyclohexanone	Cyclohexane
Isopropyl acetate	Gasoline
Methyl ethyl ketone	
Diisooctyl phthalate[a]	

The stabilizer can be effectively dissolved and dispersed in an ester by masterbatching the additive in, for example, DIOP to the extent indicated. A portion of the concentrate can then be added to the bulk of ester in order to obtain the required stabilizer concentration level. A concentrate of the stabilizer in a lighter and more active solvent like acetone can also be used. Subsequent processing of the ester removes the very minor amount of light solvent.

The authors gratefully acknowledge the contributions of many of their colleagues at Esso Research and Engineering Co. to the experimental data reported in this paper.

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[a] 6.6 g. of bisphenol-A per 100 g. of DIOP at 77° F.

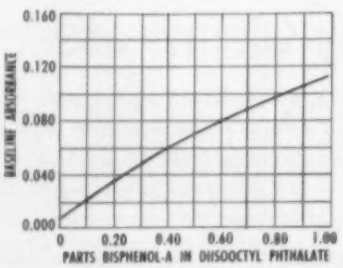
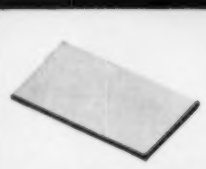
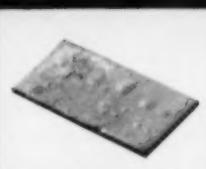
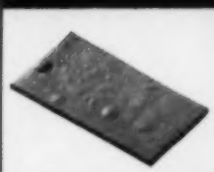
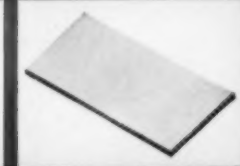


Fig. 5: Infra-red absorbance of bisphenol-A in DIOP at 6.53 microns (baseline 6.0 to 10.2 microns)

Heat Stability at 300° F	0 Minutes	20 Minutes	30 Minutes
Dioctyl Phthalate —50 parts			
Paraplex G-62 —15 parts Dioctyl Phthalate —35 parts			
Tricresyl Phosphate —50 parts			
Paraplex G-62 —15 parts Tricresyl Phosphate —35 parts			

PARAPLEX G-62

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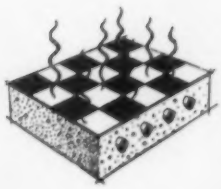

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The samples of vinyl floor tile above illustrate the superiority of PARAPLEX G-62 over conventional plasticizers in providing heat stability to vinyl compounds. This stability lets you mill vinyl compounds at high temperatures . . . helps keep them from deterioration and discoloration. The result? Shorter processing cycles, increased production.

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Materials

Now look at polypropylene. Chem. Week *78*, 69-70 (Feb. 4, 1956). Information on a new polymer, polypropylene, being produced experimentally in Germany, England, and Italy, is given. The plastic is reported to have a melting point of 150° C.

Preliminary studies on the utilization of copra meal for plastics. M. A. Templa. Philippine J. of Sci. *82*, 1-8 (Mar. 1953). Copra meal plastic molding powders prepared from local and foreign materials are described. Different methods of preparing the plastic powder are also given. The specific gravity ranges from 1.30 to 1.35. The flexural strength is a direct function of the molding pressure. The molded products are opaque and dark in color. Preheating the mixtures reduces the water absorption of the molded products. The molding and machining qualities are good. The molding powders described may be useful where water absorption and high flexural strength are of minor consideration.

Cross-linking of polymers by γ-rays in dilute aqueous solution. P. Alexander and A. Charlesby. Gt. Brit. Atomic Energy Research Establishment Report M/R 1664 (May 9, 1955). The effect of gamma radiation on polyvinylpyrrolidene in dilute aqueous solutions was studied. Protection by the addition of other materials was included.

Stabilizers for vinyl chloride and its copolymers. M. Perry and P. F. Bruins. Plastics Tech. *1*, 609-13, 634; and 673-81, 684 (Nov. and Dec. 1955). The properties and applications of stabilizers for vinyl chloride plastics are presented in detail. Detailed information on various commercial stabilizers are given in tabular form.

Intermediate for flame-resistant polymers. W. A. Reeves and J. D. Guthrie. Ind. Eng. Chem. *48*, 64-67 (Jan. 1956). The polymer-forming properties of tetrakis (hydroxymethyl) phosphonium chloride were investigated for the purpose of finding flame-resistant resins. The crystalline compound is soluble in water and some organic solvents, and reacts with most substances known to react with aqueous formaldehyde. The polymers, usually thermosetting resins, resemble resins from formaldehyde or polyhydric alcohols in physical properties, but differ significantly in combustion characteristics. Tetrakis(hydroxymethyl)phosphonium chloride reacts with many compounds containing trivalent nitrogen. Of particular significance are the melamine and urea resins, which impart flame resistance to cellulosic fibers. Phosphorous-containing phenolic resins are readily obtained by reaction with phenols. It also reacts as an alcohol by forming polymers with anhydrides of polycarboxylic acids.

Vinyl esters of perfluoro acids. T. S. Reid, D. W. Codding, and F. A. Bovey. J. Polymer Sci. *18*, 417-21 (Nov. 1955). A series of seven vinyl esters of perfluoro acids were prepared by the mercury catalyzed reaction of the acids with acetylene. Certain physical properties of the monomers are given. Homopolymers gave clear, flexible films with the exception of vinyl caprylate and caprate, which formed waxy films. Copolymerization of vinyl perfluorobutyrate proceeded readily with vinyl acetate and methyl methacrylate, but less readily with styrene, maleic anhydride, and acrylonitrile.

Food film fortifiers. Chem. Week *78*, 106, 108, 110 (Feb. 18, 1956). Vinyl chloride plastic stabilizers suitable for use in making film for food packaging are described.

New, fiber-reinforced fluorocarbon. N. L. Greenman. Materials & Methods *42*, 110-11 (Nov. 1955). A new fiber-reinforced fluorocarbon plastic is described which has excellent resistance to distortion at high temperatures and to cold flow. Inert inorganic fibers are incorporated into pure Teflon by a process that maintains the structure of the fibers. The resulting material retains its chemical and thermal properties, but suffers some loss in electrical and in dry lubricating characteristics as compared with pure Teflon. The new material can be used in continuous service up to 500° F. and intermittently to 600° F. Although not universal in application and costly to produce, fiber-reinforced Teflon promises economies in industries requiring its special properties.

Applications

The first all-plastic aerosol. Modern Packaging *29*, 98-101, 207 (Nov. 1955). An all-plastic aerosol, which is being used for cologne, is described. The container is compression molded melamine. Other parts are made of polyethylene, nylon, and buna rubber. This aerosol is break and shatter resistant, can be produced in a spectrum of soft colors, and is unaffected by alcohols, petroleum products, organic solvents, acids, and alkalies.

Fluorocarbon-bronze dry bearing material. Materials & Methods, *42*, 94-95 (Sept. 1955). The excellent frictional, chemical, and wear properties of fluorocarbon plastics are combined with the strength, thermal conductivity, and dimensional stability of metals in a new series of dry bearing materials obtained by impregnat-

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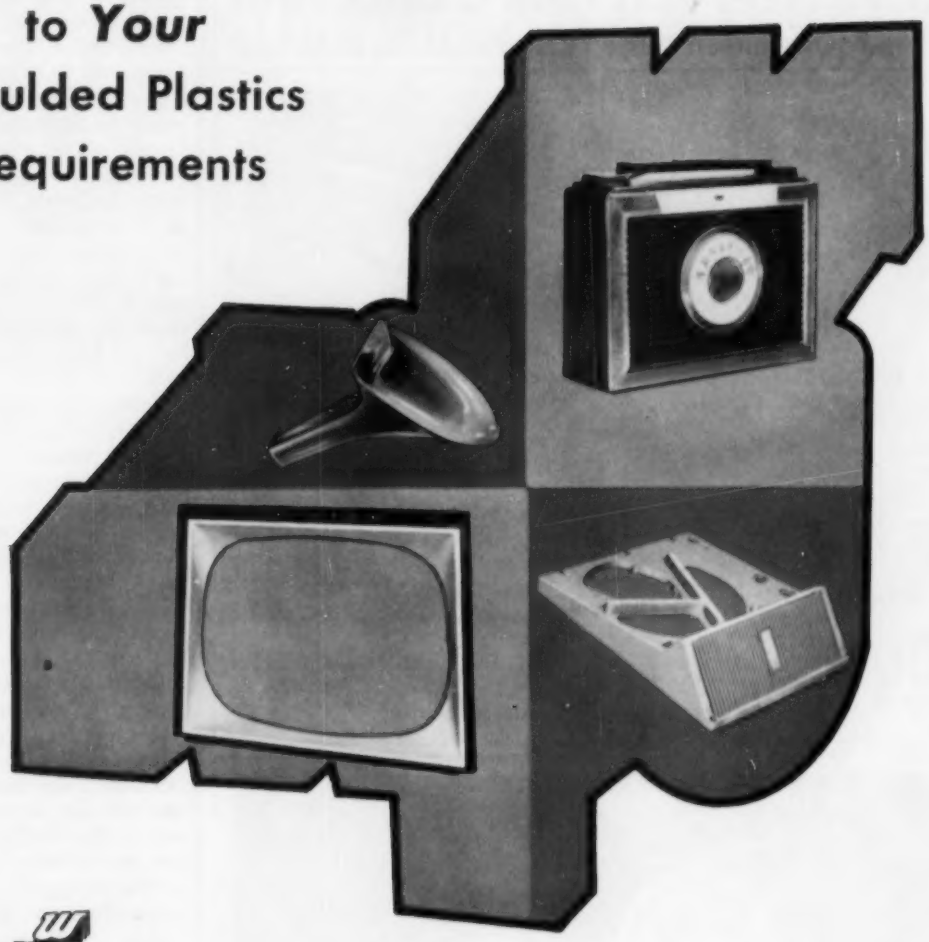

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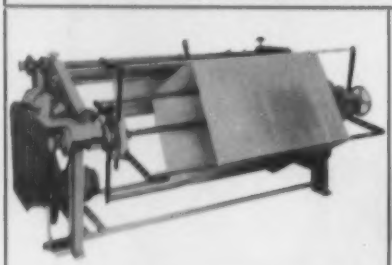

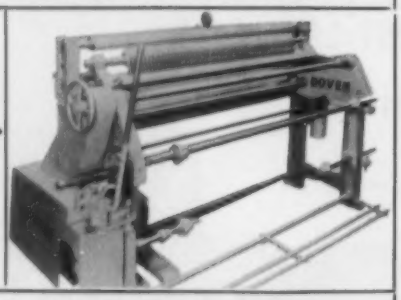

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ing a porous metal matrix with polytetrafluoroethylene resin. Maximum use temperature for the impregnated bearings is around 600° F. Potential applications exist in a wide variety of industries, wherever dry bearings would be advantageous.

Plastics in aircraft primary structures. R. Cutler. Plastics Tech. *2*, 29-34 (Jan. 1956). The problem of plastics in primary structural applications in aircraft is discussed. The current picture for reinforced plastics looks gloomy, but the future has many potentials.

There are many applications where plastics are used now in aircraft primary structures, but this use is predicated on radar requirements, making cost and weight factors secondary. Although their use in aircraft primary structures is quite limited, reinforced plastics have made tremendous inroads in less-critical strength applications. Parts in this category run the gamut from fuel tanks to electrical housing boxes, and from high temperature ducts to filler blocks. In these cases, both the designer and user are satisfied with the performance of plastics. The future should see reinforced plastics used in critical strength applications because of their strength properties alone.

Properties

Odd electrons in polymer molecules. F. H. Winslow, W. O. Baker, and W. A. Yager. J. Am. Chem. Soc. 77, 4751-56 (Sept. 20, 1955). Two series of pyrolytic derivatives from polyvinylidene chloride and pre-oxidized polydivinylbenzene exhibited paramagnetic resonance absorption. Close correlations were observed among composition, semiconductivity, and odd electron concentration of these residues. At peak absorption, the compositions of both polymer pyrolysates indicated approximately the same degree of unsaturation as exists in phthalocyanine. Their properties presumably result from extensive conjugation in a dense, rigid carbon-carbon primary valence bond mesh. The low energies apparently involved in providing con-

duction carriers lead to suggestions about electron movement in aromatic compounds.

Testing

Moisture permeability of glove materials for controlled-atmosphere boxes. J. H. Rowan. Analytical Chem. *28,* 402-03 (Mar. 1956). The moisture permeability of glove materials is found to be the limiting factor in the maintenance of dry atmosphere boxes. A comparison of available materials for this use shows the superiority of butyl rubber over all other materials tested.

An axial loading creep machine. M. H. Jones and W. F. Brown, Jr. ASTM Bulletin No. 211, 53-58 (Jan. 1956). Apparatus is described for making creep tests in tension in which bending stresses are reduced to a minimum.

Determination of silicones in textile materials. G. M. Petty. Analytical Chem. *28,* 250-51 (Feb. 1956). An estimation of the amount of silicone in textile materials is required for the control of this process for the durable waterproofing of textile materials. In a method that requires no unusual or specialized equipment, the textile material, treated with silicone, is wet-ashed, using concentrated sulfuric and nitric acids and, eventually, concentrated perchloric acid. The silica is determined by conventional methods. Attempts to extract cured silicones from textile materials by solvents gave unsatisfactory results.

Publishers' Addresses

Analytical Chemistry: American Chemical Society, 1115 Sixteenth St., N. W. Washington 6, D. C.

Chemical Week: McGraw-Hill Publishing Co., Inc., 330 W. 42nd St., New York 18, N. Y.

Great Britain Atomic Energy Research Establishment: Harwell, Berkshire, England.

Industrial and Engineering Chemistry: American Chemical Society, 1115 Sixteenth St., N. W. Washington 6, D. C.

Journal of the American Chemical Society: American Chemical Society, 1115 Sixteenth St., N. W. Washington, D. C.

Journal of Polymer Science: Interscience Publishers, Inc., 250 Fifth Ave., New York 1, N. Y.

Materials and Methods: Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y.

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Resins. K. E. Muller, F. W. Schmidt, E. Weinbrenner, and H. F. Piepenbrink (to Bayer). U. S. 2,729,618, Jan. 3. Isocyanate-modified polyester resins.

Catalysts. J. K. Sullivan (to Goodyear). U. S. 2,729,619-20, Jan. 3. Titanium tetrafluoride catalyst for polyester production.

Resin. R. A. Gregg (to U. S. Rubber). U. S. 2,729,623, Jan. 3. Resin from allyl alcohol, an oxirane, and an unsaturated dibasic acid.

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Copolymers. L. M. Welch, H. L. Wilson, and L. B. Turner (to Esso). U. S. 2,729,626, Jan. 3. Isoolefin-multiolefin copolymers.

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Sheet jointing. J. Pickering (to British Xylonite). U. S. 2,730,160, Jan. 10. Apparatus for jointing plastic sheets.

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Fibrous structure. W. A. Morgan, Jr. and J. W. Gibson (to Du Pont). U. S. 2,730,478-9, Jan. 10. Nylon structure treated with zinc chloride.

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Polyvinyl chloride. E. J. G. Balley and W. Walker (to Imperial Chemical). U. S. 2,730,513, Jan. 10. Plasticized vinyl resins.

Polymers. E. A. McCracken and A. L. Chaney (to Esso). U. S. 2,730,515, Jan. 10. Blended divinylbenzene polymers.

Resin. T. J. Suen and A. M. Schiller (to American Cyanamid). U. S. 2,730,516, Jan. 10. Water-soluble melamine resin.

Polyesters. H. A. Vogel and A. R. Bader (to Pittsburgh Plate Glass). U. S. 2,730,517, Jan. 10. Modified polyesters.

Catalyst. A. W. Birley, J. W. C. Crawford, and A. W. Jukes (to Imperial Chemical). U. S. 2,730,518, Jan. 10. Beryllium hydroxide catalyst for polyester-diisocyanate reactions.

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Copolymer. K. E. McCaleb (to General Mills). U. S. 2,730,520, Jan. 10. Copolymer of a fatty acid and a rosin acid.

Pipe. R. G. Miller (to East Coast Aeronautics). U. S. 2,731,067, Jan. 17. Apparatus for making glass fiber reinforced pipe.

Conductive membranes. J. T. Clarke (to Ionics). U. S. 2,731,411, Jan. 17. Membranes of sulfonated polyvinyl aryl compounds.

Conductive membranes. W. Juda and A. A. Kaspar (to Ionics). U. S. 2,731,425, Jan. 17. Membranes of alkylene polyamine-phenol-aldehyde condensates.

Copolymers. E. W. Lane (to Rohm & Haas). U. S. 2,731,426, Jan. 17. Sulfonated copolymers of dicyclopentadiene and maleic anhydride.

Copolymers. S. A. Harrison (to General Mills). U. S. 2,731,428, Jan. 17. Copolymers of phenolic resin esters and vinyl aromatic compounds.

Resin. W. P. Cody and T. C. Wollan (to Alkydol). U. S. 2,731,429, Jan. 17. Oil-modified alkyd resins.

Coating. H. Brunner (to Imperial Chemical). U. S. 2,731,430, Jan. 17. Vinyl aromatic-glyceride oil compositions reacted with boron halide.

Resins. P. Robitschek and D. B. Stormon (to Hooker). U. S. 2,731,431, Jan. 17. Methylpolychloro fatty acid esters stabilized with epoxidized fatty oil and reacted with polyvinyl resins.

Resin. M. K. Layman (to American Cyanamid). U. S. 2,731,438, Jan. 7. Triazine-aldehyde-polysiloxane resins.

Vinyl chloride resins. E. P. Stefl and C. E. Best (to Firestone). U. S. 2,731,440-1, Jan. 17. Stabilization of vinyl chloride resins.

Epoxide resins. S. O. Greenlee (to Devoe and Raynolds). U. S. 2,731,444, Jan. 17. Epoxide resin cured with a polyhydric alcohol.

Polyurethanes. E. L. Wittbecker (to Du Pont). U. S. 2,731,445-6, Jan. 17. Polyurethanes from piperazines.

Polyimides. W. F. Gresham and M. A. Naylor, Jr. (to Du Pont). U. S. 2,731,447, Jan. 17. Linear polyimides.

Copolymers. L. N. Bauer, H. T. Neher, and W. L. Van Horne (to Rohm & Haas). U. S. 2,731,448, Jan. 17. Copolymers of allyl esters and itaconates.

Resins. G. P. Rowland, Jr. and R. A. Piloni (to Firestone). U. S. 2,731,449, Jan. 17. Copolymers of vinyl chloride and a maleic ester.

Resins. G. E. Serniuk and L. M. Welch (to Esso). U. S. 2,731,450, Jan. 17. Thermosetting tripolymer of divinylbenzene, butadiene, and diisobutylene.

Copolymer. J. A. Price (to American Cyanamid). U. S. 2,731,451, Jan. 17. Copolymer of 2-chloro-acrylamide and methacrylonitrile.

Polymers. J. T. Edmonds, Jr. (to Phillips). U. S. 2,731,454, Jan. 17.

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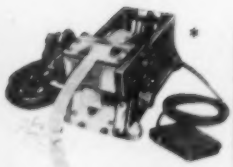

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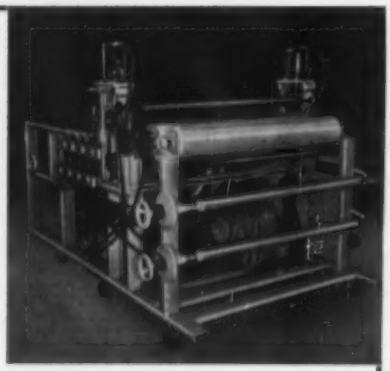

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Polymer-boric anhydride reaction products.

Resin. R. Lindenfelser and M. K. Kilthan (to American Cyanamid). U. S. 2,732,325, Jan. 24. Diaminotriazine-aldehyde resins.

Polyelectrolytes. J. T. Clarke (to Ionics). U. S. 2,732,350, Jan. 24. Copolymers of vinyl aromatic compounds and alkyl vinyl pyridinium compounds.

Ion exchange. L. E. Van Blaricom and K. R. Gray (to Rayonier). U. S. 2,732,352, Jan. 24. Tertiary amino anion exchange resins.

Expanded polymers. M. F. Fuller (to Du Pont). U. S. 2,732,353, Jan. 24. *p*-Carbomethoxy benzazide blowing agent.

Polymers. R. T. Morrissey and M. R. Frederick (to B. F. Goodrich). U. S. 2,732,354, Jan. 24. Chlorine derivatives of isoolefin-polyolefin polymers.

Copolymers. W. D. Jones (to Celanese). U. S. 2,732,358, Jan. 24. Copolymers of acrylonitrile and N-benzylacrylamide.

Polymerization. H. W. Coover, Jr. and J. B. Dickey (to Eastman Kodak). U. S. 2,732,363, Jan. 24. Polymerization of acrylonitrile in the presence of polymers.

Polymerization. C. H. Basdekis (to Chemstrand). U. S. 2,732,364, Jan. 24. Polymerization of acrylonitrile-vinylpyridine.

Resin. B. H. Tubbs, F. B. Nagle, and P. C. Woodland (to Dow). U. S. 2,732,366, Jan. 24. Vinyl aromatic resins.

Resins. E. C. Shokal (to Shell). U. S. 2,732,367, Jan. 24. Polyepoxides.

Resins. A. F. Shepard (to Hooker). U. S. 2,732,368, Jan. 24. Phenolics.

Polymers. J. R. Caldwell and E. H. Hill (to Eastman Kodak). U. S. 2,732,369, Jan. 24. Polymers of N-2-norcamphanyl acrylamides.

Polymers. D. W. Codding (to Minnesota Mining). U. S. 2,732,370, Jan. 24. Polymers of fluorocarbon vinyl ethers.

Polymerization. H. W. Wehr and F. B. Nagle (to Dow). U. S. 2,732,371, Jan. 24. Alpha alkyl styrene dimers.

Extrusion. E. Tunniclift and R. Barlow (to British Insulated Callender's). U. S. 2,732,592, Jan. 31. Extrusion device.

Corrugated roofing. G. Andreoli and A. Andreoli. U. S. 2,732,886, Jan. 31. Corrugated laminated roofing.

Phosphors. G. G. Eichholz and J. L. Horwood (to Great Britain). U. S.

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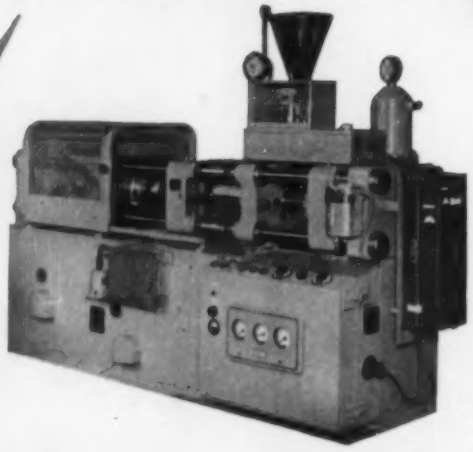

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Germany

2,733,216, Jan. 31. Plastic scintillation phosphors.

Blender. L. F. Street (to Welding Engineers). U. S. 2,733,051, Jan. 31. Blending plastics and fluids.

Polyamide. W. E. Roseveare (to Du Pont). U. S. 2,733,162, Jan. 31. Heat-resistant polyamide.

Printing. S. Pinto. U. S. 2,733,180, Jan. 31. Printing on plastic films.

Expanded resin. S. P. Kish and L. C. Coe (to Kish Plastics). U. S. 2,733,221, Jan. 31. Expanded phenolic resin.

Resin. J. F. McKay, Jr. (to Esso). U. S. 2,733,227, Jan. 31. Reaction product of olefin-diolefin resin and coumarone-indene resin.

Polymer blends. I. O. Sayler and J. A. Herbig (to Monsanto). U. S. 2,733,228, Jan. 31. Blends of polyvinyl chloride with ethylene-vinylene carbonate copolymers.

Flame retardants. N. O. Brace (to Du Pont). U. S. 2,733,229, Jan. 31. Dialkyl polyvinyl phosphates.

Polyamides. H. Ufer (to Badische Anilin). U. S. 2,733,230. Jan. 31. Film-forming polyamides.

Sulfonating. W. C. Bauman and R. M. Wheaton (to Dow). U. S. 2,733,-231-2, Jan. 31. Sulfonating aromatic copolymers.

Polymers. R. E. Miegel, C. G. Niemann, and J. C. Sauer (to Du Pont). U. S. 2,733,233, Jan. 31. Polymers of vinyl esters of N-carbacyl-alpha-monoamine carboxylic acids.

Mold. J. F. Bryer and A. R. Blackburn (to Ram). U. S. 2,733,494, Feb. 7. Plastic mold.

Tube. V. T. Ohrstrom (to Svenska Kabsylfabriken). U. S. 2,733,837, Feb. 7. Sealable paste dispenser tube.

Textile treatment. C. A. Robinson (to Arnold Hoffman). U.S. 2,734,004, Feb. 7. Polymers of N-methylol polypyrrolidones.

Graft polymers. E. I. Jones, S. M. Todd, and L. Wood (to Imperial Chemical). U.S. 2,734,040-1, Feb. 7. Graft acrylonitrile copolymer.

Coating. A. J. Carter, R. C. Hansen, and C. M. Heinen (to U. S.). U.S. 2,734,042, Feb. 7. Coating of polychloroprene and an alkaline earth metal fluoride.

Polymers. J. A. Nelson (to Du Pont). U. S. 2,734,045, Feb. 7. Curing polyalkaline ether polyurethane polymer with halogen compounds.

Resins. J. F. Nelson, R. F. Leary, and F. W. Banes (to Esso). U.S. 2,734,046, Feb. 7. Petroleum resins.

More and More Manufacturers are Installing

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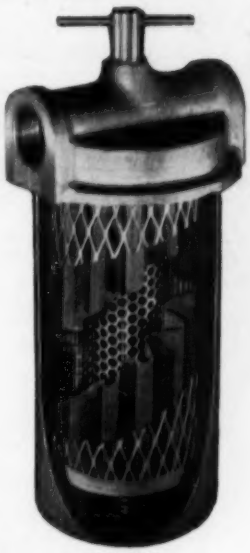

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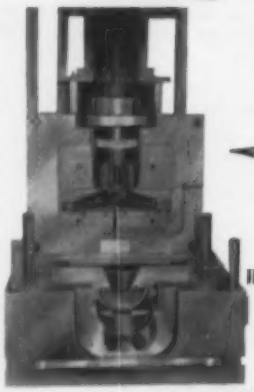

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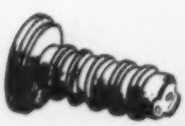

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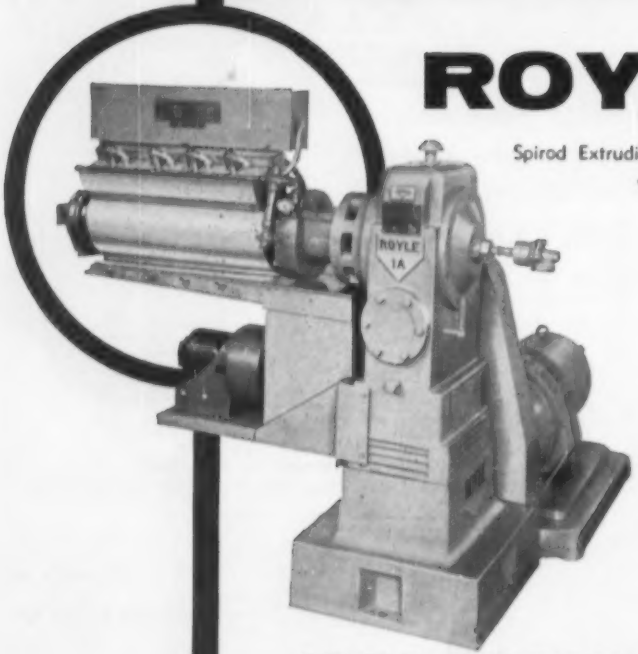

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The model 42PC Impulse Trim-Sealer is claimed to make possible for the first time the trim-sealing of lengths greater than 20 inches. This machine makes seals that separate and divide, making two completely sealed and trimmed edges without using a knife. It promises great versatility in packaging, where, for example, it can package flat triangular or rectangular objects in close-fitting plastic bags. The machine will produce seals up to 42 in. in length. *Vertrod Corp., 2037 Utica Ave., Brooklyn, N. Y.*

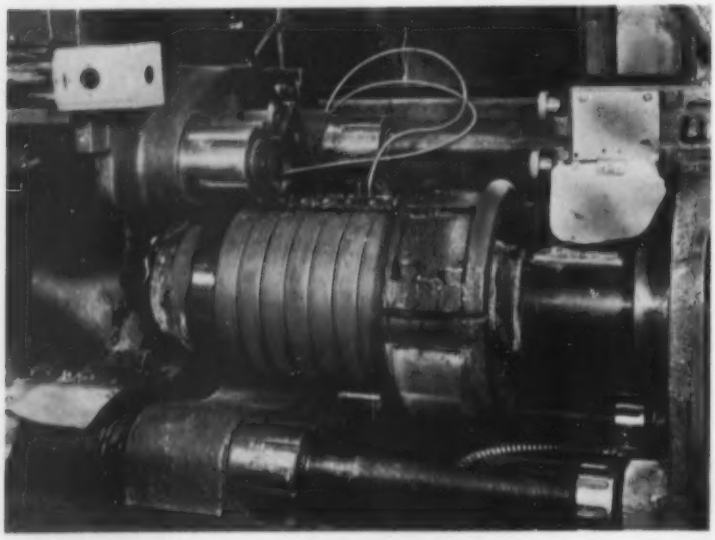
Injection heating cylinders

A double-capacity replacement cylinder and heater for the popular 8-oz. Reed-Prentice injection machine has been announced by IMS. The new cylinder has twice the wattage of the original heater, yet operates at lower surface temperatures because of greatly increased area. It is reported that thin-wall sections molded with the new heater are more craze- and crack-resistant because the plastic is not degraded during the melting process. The replacement cylinders and heaters are also available for most HPM, Watson-Stillman, Impco and other machines by special order. Reports indicate reduced maintenance and longer life.

IMS will also furnish polyliner-type cylinders (see MODERN PLASTICS, February 1956, p. 109), and will supply without obligation a cylinder of its own all-welded, integrally heated design to any molder using a polyliner who wishes to compare performance, provided the test results will be made available for publication. *Injection Molders Supply Co., 3514 Lee Rd., Cleveland 20, Ohio.*

Cutter for coated fabric

An automatic cutter measures, cuts, conveys, and stacks vinyl coated fabrics. Materials up to 60 in. wide are cut with exceptional accuracy by the machine; 72-in. lengths are cut at the rate of 14 pieces/minute. The machine is said to function best when installed in-line and synchronized with other machines—extruders, etc.—to use all its automatic features. *Hobbs Mfg. Co., 26 Salisbury St., Worcester, Mass.*



IMS replacement cylinder and heater for 8-oz. Reed-Prentice

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Specially designed for plastics forming, drape forming, and vacuum packaging, Model 12 Pak-O-Vac is a semi-automatic machine, completely self-contained and using 230-v., 60-c. power. It accommodates a wide variety of products without special set-up, handles a broad range of plastics sheet materials and roll films, and no special training is needed to operate it. Using 3000-w. heaters, the Pak-O-Vac has a vacuum pump of 4.5-cu. ft./min. capacity and weighs about 375 pounds. *Product Packaging Engineering, 5747 Marilyn Ave., Culver City, Cal.*

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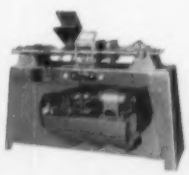

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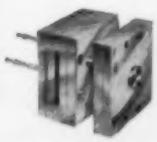

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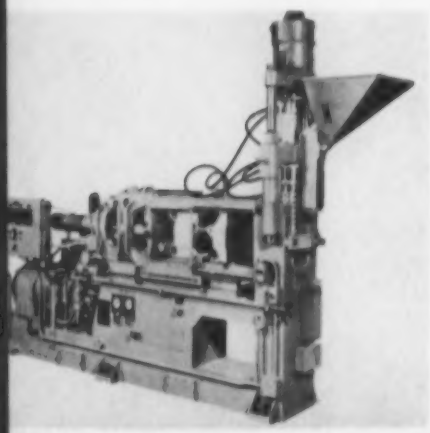
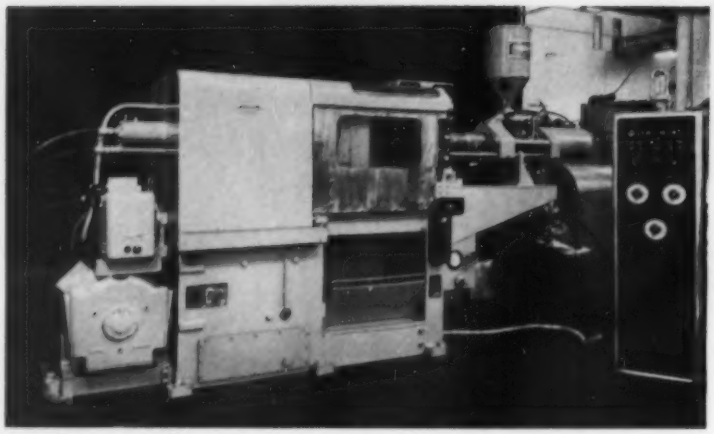
Injection-molding machine

A new 4-oz. Lester automatic injection machine includes adjustable stroke and mold opening, a new ejector pattern that conforms with the recommended standards of the S.P.I., and a frame large enough to accommodate DME mold bases up to 18 by 13.4 inches. It is designed with such a natural combination of features for the field of packaging—large platen area, generous plasticizing capacity, rapid set-up features, one-piece frame for flash-free locking—that it has been dubbed the "Package Maker." It comes equipped with fail-safe, low-pressure closing with signal light, two-min. booster pump circuit, and sprue-shearing attachment. *Lester-Phoenix, Inc., 2711 Church Ave., Cleveland, Ohio.*



Lester-Phoenix "Package Maker," 4-oz. automatic injection machine



Projectile and Engineering 1.5-oz. injection molding machine

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An entirely new method of bonding copper and copper alloys to glass, ceramics, metals, paper, plastics, etc., has been announced. The copper is bonded at temperatures above its melting point, and forms a permanent bond. The copper will not peel or discolor, but retains its bright copper color where it contacts the glass base material. It can be plated and soldered and can be used at temperatures up to the point at which the base material softens or degrades, without visible oxidation. Licenses to use this process may be obtained from: *Haddam Mfg. Co., 30 Rockefeller Plaza, New York 20, N. Y.*

1.5-oz. injection machine

Peco's model 20MS20 injection-molding machine has a rated capacity of 1.5 oz./shot of polystyrene on single feed and 2.0 oz. on double feed, with a plasticizing capacity of 35 lb./hour. The rate of injection is 6.5 cu. in./sec. and greatest injection stroke is 6.5 inches. The space between tie bars is 10.25 in. sq., accommodating molds with a maximum height of 13 inches. Clamping force is 78 tons and minimum dry cycle time is 4 sec. with single feed, 6 sec. with automatic double feed. Maximum injection pressure on material is 16,000 p.s.i. Particular attention has been given in design to reliability of operation and maintenance of consistent product quality. The heater has two-zone control and a maximum power of 5 kilowatts. A hyper-sensitive safety device protects the mold from damage during closing in case of ejection failure, etc. *Peco Machinery Sales (Westminster) Ltd., 28 Victoria St., London, S.W.I., England.*

Controlling tachometer

A new tachometer not only indicates speed, but actuates self-contained power relays that signal overspeeds and underspeeds. It will sound alarms, stop or start equipment, open or close valves, and so on, when limits are exceeded. In addition to the speed-indicating pointer, the instrument has high- and low-limit pointers that are independently adjustable. The instrument is available with any of 48 different scales. (R.P.M. scale shown in cut.) *Metron Instrument Co., 432 Lincoln St., Denver 3, Colo.*

Low-cost recorder

A portable, strip-chart recorder with appropriate sensing devices will record temperature, pressure, speed, movement, etc. The instrument can be mounted on table or wall, is ruggedly constructed for industrial use, and has a reported accuracy of 1% of the full-scale (5-in.) deflection;

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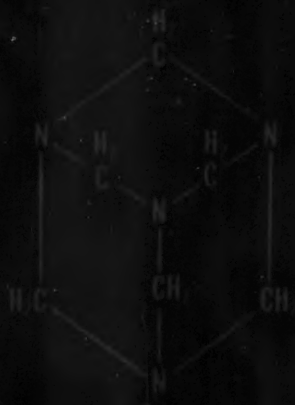

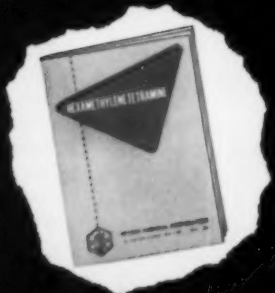

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it is said to have many features found in recorders costing over twice as much. *C. H. Stoelting Co., 424 N. Homan Ave., Chicago 24, Ill.*

Replacement finishing barrels

A line of replaceable finishing barrels, ranging in size from 1 gal. to 8 cu. ft., is offered for the first time for replacement in Rampe equipment and that of other makers. Replacement barrels may be had with a heavy-duty seamless vinyl lining. *Rampe Mfg. Co., 14915 Woodworth Ave., Cleveland 10, Ohio.*

Rotating joint for fluids

A rotating joint for use in heating and cooling systems for extrusion screws and mill rolls has four separate rotating passages, and so can be used to circulate two different fluids. The larger (outer) pair turns on a different center than the smaller pair, thereby compensating for screw or roll eccentricity and eliminating binding. All rotating members can be easily removed. *Rotherm Engineering Co., Inc., 7280 W. Devon Ave., Chicago 31, Ill.*

Automatic stacker

Simplicity of design, high production rates, and flexibility of operation are reported as outstanding features of the new Alfa automatic stacker. Operating at speeds up to 100 ft./min., the stacker may be obtained as an individual unit or in combination with a rotary cutter that measures and cuts the material to be stacked. Equipped with two stations, the stacker switches to the second station when the first station is full, and so on. *Spadone Machine Co., South Norwalk, Conn.*

Relief valve

A new line of relief valves for ⅛-in. pipe for pressures ranging from 50 to 1000 p.s.i., available in brass or steel, is added to the 5100 series of larger sizes. The valves feature a lightweight, in-line design and a special safety feature: the relief pressure is adjusted internally and is therefore tamper-proof after the valve has been installed. The valve exhibits no leakage within as little as 2% of the preset cracking pressure and reseats without leakage within 5% of the setting. *James-Pond-Clark, 2181 E. Foothill Blvd., Pasadena 8, Calif.*

Slow-speed lineal tachometer

The new Jacquet Indicator, Catalog No. 2304-I, reads speeds directly in in./minute. It is especially designed for measuring the very slow lineal speeds often encountered in plastics extrusion, welding, etc., where precise setting of slow speeds is important. It covers all speeds from 0 to 300 in./min., reading to the nearest ¼ in./min. with a guaranteed accuracy of 0.5 percent. *Herman H. Sticht Co., Inc., 27 Park Pl., New York 7, N. Y.*

Rotary laminating press

Looking much like an oversized clothes wringer, a new rotary press is ideally suited for applying pressure to insure good adhesive bonding of laminated

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Designers of a new electric frying pan located the control box underneath the handle. This position was ideal for servicing, but it meant that the control box would be completely immersed in dishwater when the pan was cleaned. One of the primary problems was to find a material that would effect a watertight seal under the three screws fastening down the control box cover. Requirements were stiff. The material would be exposed for long periods to 450°F. It would have to compress but not extrude under the torque pressure of the screws. Many materials were tried. Only DUROID 5600 supplied the desired combination of resistance to heat and cold flow. It's on the pan now — we're even fabricating the pieces.

DUROID 5600 is another example of where Rogers has taken a good material — in this case, TEFLON — and made it better for certain applications. If you have a product idea or improvement that requires a special material, let us go to work on it. Combining chemicals and fibres to develop special material properties is our business. Contact Dept. P.

* Registered trademark of Du Pont Company for its tetrafluoroethylene resin.

Material ideas for product improvement

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panels. The neoprene-covered pressure rolls are aligned vertically regardless of the panel thickness. The Wring-Master is provided with positive nip adjustment for thicknesses up to 5 in., and a neoprene-covered stabilizing roll behind the nip prevents fluttering of rigid panels while passing through at speeds up to 30 ft./minute. The rolls can be loaded up to 8000 lb., giving a lineal load of about 150 p.s.i. on a 48 in. wide panel. Larger loading capacity is available. *Rodney Hunt Machine Co., Orange, Mass.*

Big vacuum-forming machine

A vacuum-forming machine designed specifically for the lighting industry has a maximum forming area of 50 by 50 inches. It can economically produce ceiling pans up to 4 ft. square. The clamping frames are fully adjustable to allow the forming of one full-size pan, two half-size pans, or four 2- by 2-ft. pans on the same machine. Feed stock can be in sheet or roll form. Production rates on 2-ft. sq. pans of up to 400 per hr. are reported as possible. *The Auto-Vac Co., 1984 State St., Bridgeport 5, Conn.*

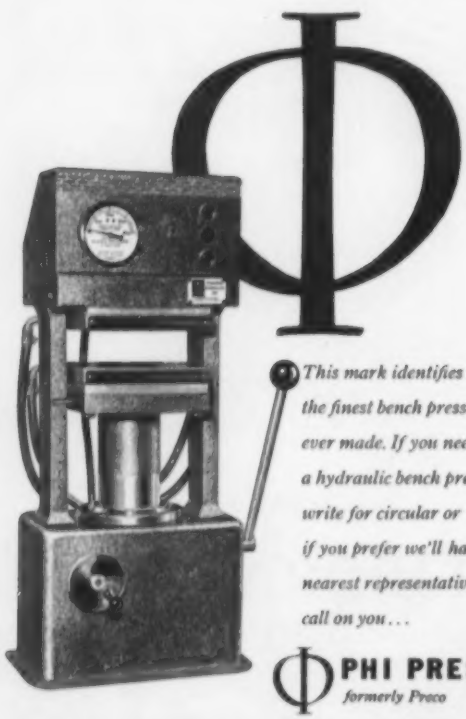
Auto-Vac vacuum forming machine developed for the lighting industry

Blow-molding machine

Intended for blow-molding freshly extruded thermoplastic tubing, a new machine forms hollow parts of a wide range of shapes, e.g., bottles, doll parts, etc. Equipped with two heads, it can be used with two different molds at once, so that two completely different items can be made simultaneously. Parts are neatly trimmed as they leave the mold. Items may be molded with walls as thin as 2 mils. *Martin Rudolph, Blumenstrasse 20, Postfach 322, Velbert (Rheinl.), West Germany.*

Cooling roll inserts

A cylindrical insert for cooling rolls, like those used in laminating plastic films and in web printing, has a spiral rubber rib vulcanized directly to the cylindrical metal surface of the insert. The turns of this rib fit snugly against the inside surface of the roll into which the device is inserted, thus forming a shallow, narrow, rectangular channel for the cooling water. At even moderate cooling-water rates, the velocity of flow is high, *close to the surface*, insuring excellent heat transfer and local uniformity of temperature. The pitch of the spiral reduces in the direction of flow, so the water velocities are higher at the outlet end. Thus the gradual heating-up of the cooling



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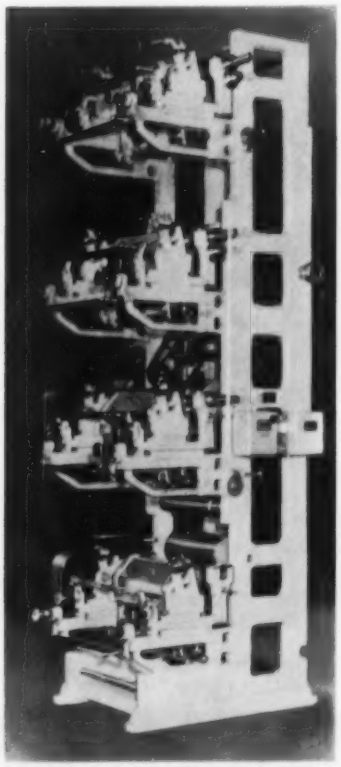
water is at least partly offset by increasing the amount of heat transfer on the water side of the roll surface. The cooling insert is said to have been particularly successful in equipment for laminating polyethylene to paper at speeds up to 600 ft./minute. *F. R. Gross Co., P. O. Box 2044, Akron 11, Ohio.*

Vertical four-color press

A flexographic printing press, specially designed to fit between a polyethylene film extruder and a bag maker, occupies only 2 sq. ft. of floor space. Ten ft. high, the press is designed to permit continuous two-color printing of the film without any down time for change-over from one design to the next. This is accomplished by alternating pairs of printing stations. Extrusion of the film need not be interrupted and only two or three printing impressions are missed at change-over, so real savings in material and labor can be made. In printing three or four colors, however, production stops during change-over. The machine can also be made in a horizontal frame if desired. *Manhasset Machine Co., Mineola, N. Y.*



Manhasset Machine Co. flexigraphic four-color printing press

Conveyor for cemented parts

Adhesive bonding of small plastic articles is put on assembly-line basis by a new conveyor that applies pressure to two cemented plastic parts as they pass along it. The bottom part of the conveyor is a 6 in. wide steel slat linked to two heavy-duty chains. Die-cast aluminum holders are attached to the slat. The top part is a rubber belt with spring loaded rollers that apply pressure to items between the rubber and steel parts, which run at the same speed. The clearance between the two gripping members is adjustable and the conveyor is made in lengths from 10 to 60 feet. *Gurey Mfg. Co., 342 Himrod St., Brooklyn 37, N. Y.*

Dipping tank

A constant-level plastic heating tank, U/L approved, is designed for either conveyorized or hand dipping of metal parts in strippable plastics for protection against corrosion or other damage during storage and shipping. Especially suited to ethyl cellulose and cellulose acetate butyrate strippable coating materials, the tank is agitated to provide rapid melting and remove bubbles. Close control of temperature is maintained by a thermostat and a circulating-oil jacket that surrounds the entire compound chamber. *D. C. Cooper Co., 1467 S. Michigan Ave., Chicago, Ill.*

Heat distortion tester

Five specimens can be tested at the same time by a new five-gang heat-distortion tester. Complete within itself, each of the five units includes an automatic deformation indicator, pilot light, heating controls and a cooling system that speeds the testing. Rates of temperature rise from 2 to 25° C. (4 to 45° F.) per min. can be obtained. Each unit will accommodate specimens from ⅛ by ½ in. to ½ by ½ in. and fiber stresses of 66 or 264 p.s.i. may be applied. *Tinius Olsen Testing Machine Co., 5235 Easton Rd., Willow Grove, Pa.*

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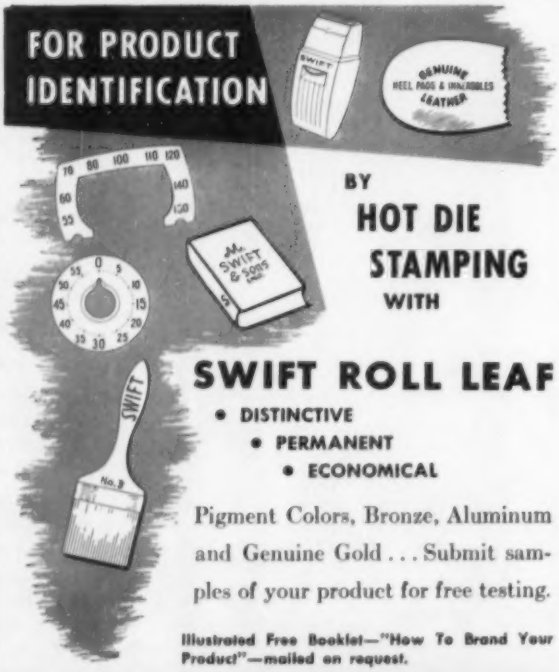

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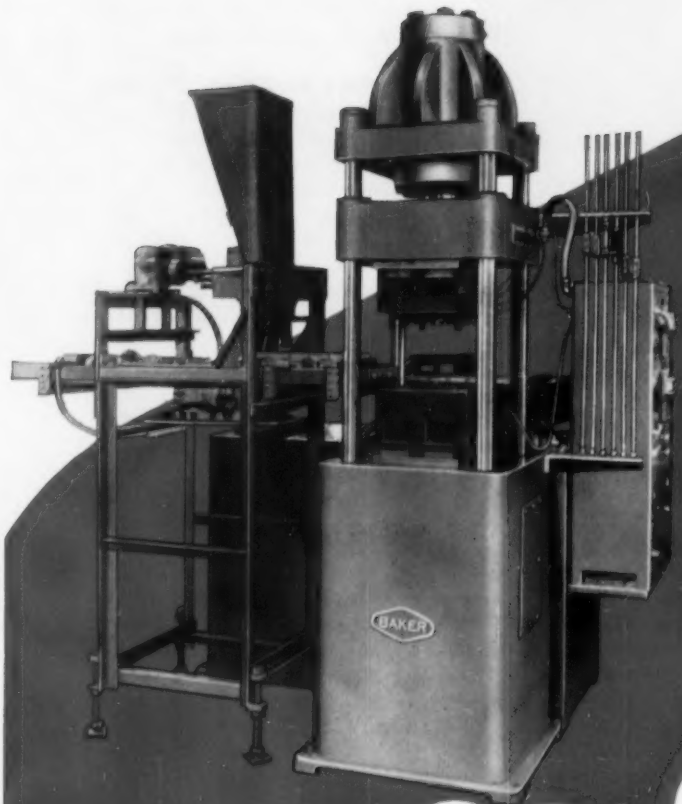

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Books & Booklets

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"Plastics Progress 1955"

Published in 1956 by Philosophical Library, 15 E. 40th St., New York 16, N. Y. 432 pages. Price: $17.50.

Based on papers given at the British Plastics Convention, June, 1955, this book brings together some of the important recent developments in plastics technology. General headings include: polymer structure and properties; expanded plastics; thermoplastics; extrusion; injection molding; patents; foundry resins; and glass-reinforced plastics.

"Chemical Pilot Plant Practice"

By Donald G. Jordan

Published in 1955 by Interscience Publishers, Inc., 250 Fifth Ave., New York 1, N. Y. 152 pages. Price: $3.50.

A complete coverage of the nature of pilot plants is not intended; however, a generalized discussion of services that pilot plants perform, theory and application, tests, and the nature of development work, is presented. General headings include: the scale-up problem; handling of solids, liquids, and gasses; chemical reactors; separation process; cost estimating; and report writing.

"Automatic Process Control for Chemical Engineers"

By Norman H. Ceaglske

Published in 1956 by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. 228 pages. Price: $6.75.

Written especially to familiarize the chemical engineer with the fundamentals of automatic control, this book presents the basic mathematical principles of process control.

In addition to a review of principles and their application to simple control systems, the author includes a discussion of methods for calculating the dynamic response of processes. Examples and illustration are given to demonstrate the use of equations. Typical problems are offered at the conclusion of each chapter.

"Kunststoff Verarbeitung"

By Karl Mienes

Published in 1955 by Econ-Verlag GMBH, Dusseldorf, Germany. 112 pages. Price: DM 7.80 (ca $1.87).

The progress made in plastics processing in recent years, including the processing of formless plastics in the solid, liquid, dissolved, and dispersed states, as well as the fabrication of plastic shapes, are discussed in this non-technical book. Suggestions for practical application are also given.

Subjects include processing of thermoplastics; calendered, blown, and extruded film; polystyrene sheet; reinforced plastics; pipe and profiles of silicones, nylons, and reinforced plastics; fibrous glass-polyesters (hand lay-up and molding); injection molding of rigid vinyl and low-pressure polyethylenes; etc.

Spreaderless heaters. Pamphlet discusses design, maintenance, and cost of spreaderless heaters. This report is available only to injection molders requesting it on company letterhead. *Injection Molders Supply Co., 3514 Lee Rd., Cleveland 20, Ohio.*

Technical digests. Monthly publication entitled "Technical Digests" provides abstracts in English of selected articles appearing in European technical and industrial journals. Such fields as ceramics and glass; chemicals; corrosion; protective coatings; finishing processes; electrical engineering and equipment; etc., are covered. $24.00 a year; $2.50 a single issue. *O.E.E.C. Mission Publications Office, 2000 P St., N. W. Washington 6, D. C.*

Injection machines. Pamphlet gives specifications, advantages, characteristics, and engineering drawings for a line of injection molding machines from 4- to 32-oz. capacity. *Reed-Prentice Corp., Worcester 4, Mass.*

Promotion piece. A styrene coffee measure which simulates a TV dial, flips a black and white card to expose a color print of the same scene. Object—an unusual promotion piece aimed at emphasizing a color program. *House & Garden, a Condé Nast Publication, 420 Lexington Ave., New York 17, N. Y.*

Ultra-violet absorbers. This 20-page booklet describes a line of light absorbers for use in the control of effects of ultra-violet radiation on plastics and other materials. These absorbers, designated Uvinuls, and supplied in powder form, can be compounded with polymethyl methacrylate, polyesters, pressure-sensitive adhesives, and others to provide color stabilization and to minimize crazing, degeneration, and the like. *Antara Chemicals, General Aniline & Film Corp., 435 Hudson St., New York 14, N. Y.*

Expandable polystyrene. Bulletin C-6-226 describes end-use applications of expandable polystyrene in the do-it-yourself market, housewares, toys, games, furniture, insulation and construction, displays, and packaging. *Koppers Co., Inc., 1301 Koppers Bldg., Pittsburgh 19, Pa.*

Injection molding. A 16-page booklet contains general information about the molding of polyethylene, together with a suggested guide for correcting molding difficulties. *Eastman Chemical Products, Inc., Kingsport, Tenn.*

Glass-reinforced alkyd. A 12-page technical brochure describes a glass-reinforced alkyd-base polyester insulating material. Comparison charts, a characteristics chart, and information on applications are included. *John*

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Harder Fenstermacher, Widmann Bldg., Corry, Pa.

Chemical company. "Tough Enough to Grow" is a booklet which gives history, key personnel, facilities, equipment, principle products, etc., of a chemical company. *Arapahoe Chemicals Inc., 2800 Pearl St., Boulder, Colorado.*

Injection molding. Bulletin 5601 explains the operation of a line of injection molding machines. Important specifications are given. *Hydraulic Press Mfg. Co., Mt. Gilead, Ohio.*

Lining material. Bulletin describes a lining material that can be applied to inexpensive containers, tanks, pipes, etc. Characteristics, properties, and examples of various applications are included. *Garlock Packing Co., Palmyra, N. Y.*

Self-tapping inserts. Booklet describes a self-tapping bushing, threaded inside and out, which has cutting edges that enable it to be installed in either a drilled or cored hole. *Groov-Pin Corp., 1125 Hendricks Causeway, Ridgefield, N. J.*

Plastic tools. Technical bulletin describes the advantages of plastic tools. Instructions are given for using a gel-coat resin for patch work. Construction of molds and preparation of mold surfaces are also covered. *The Marblette Corp., 37-21 Thirtieth St., Long Island City 1, N. Y.*

Rubber rolls. Answering the question, "How thick should a rubber roll be?" Report #8 is one of a series intended to assist in the design and selection of rolls for specific plant applications. *Rodney Hunt Machine Co., Dept. 1 R, Orange, Mass.*

Fluids and lubricants. Booklet 6500D describes properties, applications, and characteristics of synthetic fluids and lubricants which are polyalkylene-glycol derivatives. *Carbide and Carbon Chemicals Co., 30 East 42nd St., New York 17, N. Y.*

Rubber latices. Synthetic rubber latices are described in an eight-page booklet. Uses of each latex are given. *Latex and Lotol Sales, Naugatuck Chemical Div., U. S. Rubber Co., Naugatuck, Conn.*

PVC blowers. Bulletin 102 contains specifications for a line of unplasticized rigid polyvinyl chloride blowers. Performance tables, chemical resistance charts, and information on applications are included. *Industrial Plastic Fabricators, Inc., Norwood, Mass.*

Adhesives, coatings, sealers. A 12-page catalog lists properties and applications of a variety of adhesives, coatings, and sealers. *Adhesives and Coating Div., Minnesota Mining and Mfg. Co., 411 Piquette Ave., Detroit 2, Mich.*

Vinyl inks. Bulletin 02-69 describes a line of vinyl inks which may be applied by stencil, silk-screen, painting, or spraying;

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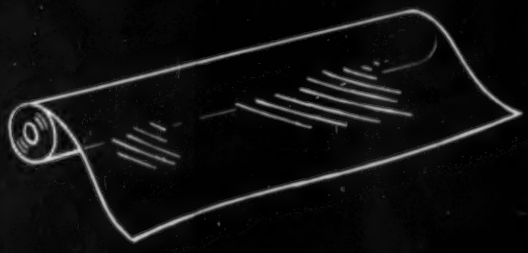

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standard colors are listed and packing data are given. *Harwick Standard Chemical Co., 60 South Seiberling St., Akron 5, Ohio.*

Permanent markings. A method of permanent markings for dials, panels, scales, and schematics is outlined. *Photo Chemical Products, 479 Walton Ave., New York, N. Y.*

Atomic terms. This popular-type glossary on atomic energy contains 101 frequently used terms from "A" for accelerator to "Z," a symbol for atomic number. *Esso Research and Engineering Co., 15 W. 51st St., New York, N. Y.*

Patents. More than 900 additional Government-owned patents available for private use on a royalty-free basis are described in PB 111854. Abstracts of the patents are given with special reference to any novel features. *$3.75. OTS, Dept. of Commerce, Washington 25, D. C.*

Diamond Compounds. Folder describes diamond compounds for fast stock removal or fine polishing in the production of plastic molds, die casting dies, cutting tools, bearings, gages, etc. Special applicator gun is also described. *Hyprez Div., Engis Equipment Co., 431 S. Dearborn St., Chicago 5, Ill.*

Acrylate elastomer. Compounding formulations, curative systems, and test data on a solvent-resistant acrylate elastomer are contained in technical bulletin ODB 55-21. *Monsanto Chemical Co., St. Louis 4, Mo.*

Plastisol system. Data sheet #83 describes the advantages of a three-phase operation designed to insure corrosion resistance of industrial equipment. *Quelcor, Inc., Front and Broomall Sts., Chester, Pa.*

Polyethylene film. Booklet describes 16 case histories involved in packaging products in polyethylene film. Advantages and characteristics are given. *Bakelite Co., Div. of Union Carbide and Carbon Corp., 30 E. 42nd St., New York 17, N. Y.*

Polyethylene resin. Revised brochure contains information on general properties, method of manufacture, uses, and methods of processing and fabrication for a line of polyethylene resins. *U. S. Industrial Chemicals Co., Div. of National Distillers Products Corp., 99 Park Ave., New York 16, N. Y.*

Humidity recorders. Bulletin H1008 describes a line of portable recorders for relative humidity and temperature. *The Bristol Co., Waterbury 20, Conn.*

Dust collector. Bulletin 172CFF describes a package-type dust collector. Specifications, advantages, etc. are given. *Green Fuel Economizer Co., Inc., Beacon, N. Y.*

Polyethylene. Booklet gives properties, test method, and values for a line of polyethylene compounds designed for extrusion

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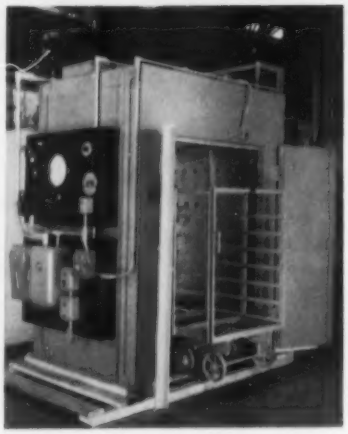

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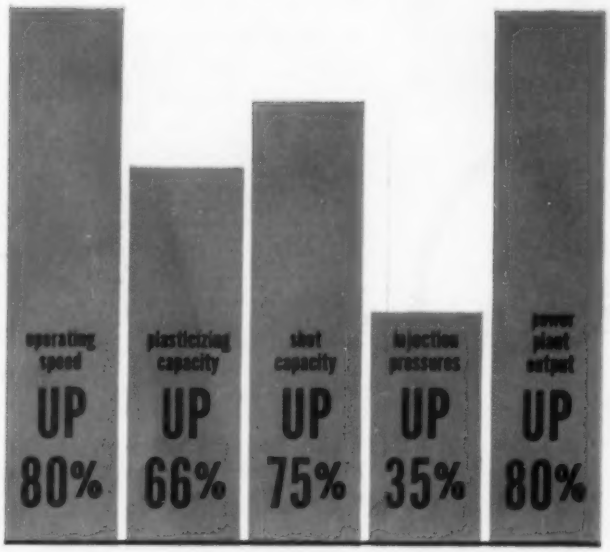

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and lamination of film. *Spencer Chemical Co., Dwight Bldg., Kansas City 5, Mo.*

Pipe. Three pamphlets, 118 to 120, give specifications, properties, suggested applications, and prices for a line of polyethylene, PVC, and Kralastic pipe and pipe fittings. *Skyline Industries, Titusville, Pa.*

Technical literature. Containing 11 separate folders and sheets, this series presents information on properties, compounding, formulating, processing, etc., for Pliovic vinyl and Plio-Tuf styrene. *The Goodyear Tire and Rubber Co., Inc., Akron 16, Ohio.*

Styrene. Vol. 1, No. 8 of "Molding News," covers five styrene grades from general purpose to extra-high-impact. Properties and general discussions are provided. *Bakelite Co., a Div. of Union Carbide and Carbon Corp., 260 Madison Ave., New York 16, N. Y.*

World trade. The answers to many everyday foreign trade problems are contained in revised World Trade Data Booklet. In chart form (52 pages), the booklet presents information on mail, telephone, radio, and cable message rates and regulations, electric current, conversion factors, etc. 50¢. *Exporters' Digest, 253 Broadway, New York 7, N. Y.*

Accident prevention. Designed as a basic text for safety, this 1341-page manual includes the information needed to organize a comprehensive safety program. $13.50. *National Safety Council, 425 N. Michigan Ave., Chicago, Ill.*

Pipe, fittings, valves. Three bulletins (Van-Cor 1, 2, 3) describe pipe, fittings, and valves made of a rigid unplasticized PVC that is resistant to many industrial chemicals and wastes. Specifications, properties, and advantages are given for each. *Colonial Plastics Mfg. Co., 8007 Grand Ave., Cleveland, Ohio.*

Metal forming. A collection of "Metal Forming Bulletins" outlines the manufacture, uses, and advantages of plastic draw dies,

stretch press dies, and hydroform dies; gives die manufacturing directions; explains the selection of various tooling materials; and describes the methods of heat curing resins when tools with special properties are required. *Marblette Corp., 37-21 Thirtieth St., Long Island City 1, N. Y.*

Thread inserts. Bulletin 625-A presents design data on wire thread inserts for engineers in the automotive, aviation, military, and general industrial fields designing in plastics, aluminum, magnesium, and wood, as well as iron and steel. A separate bulletin (689 A) gives military standards for drilling depths, class of fit, gages, etc. *Heli-Coil Corp., Danbury, Conn.*

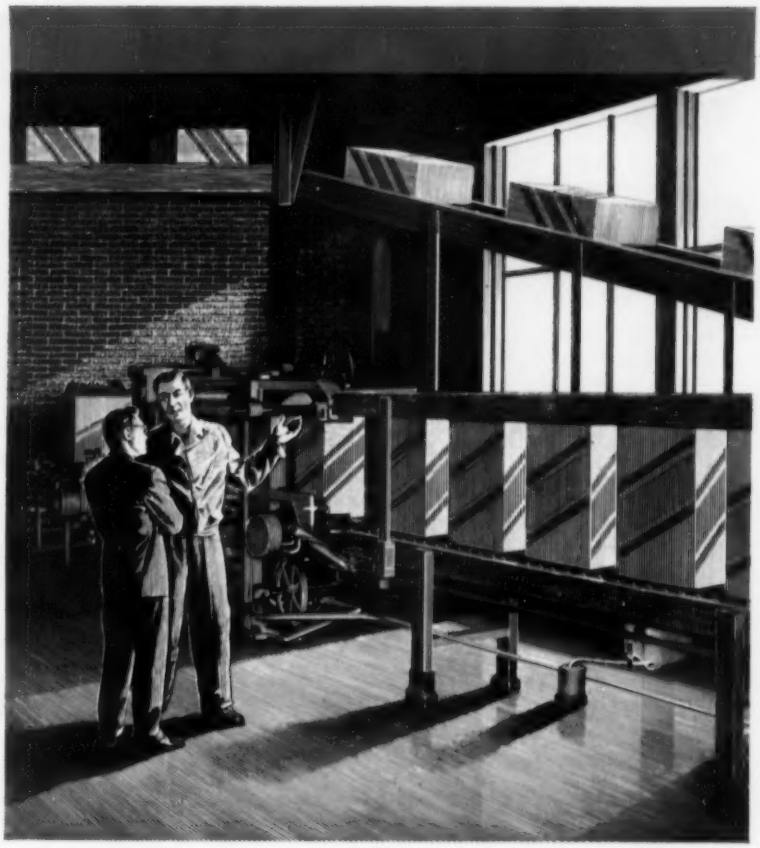
Vinyl-metal laminates. Brochure entitled "Col-O-Vin Meets Metal" describes a semi-rigid vinyl sheeting that can be bonded to steel or other non-ferrous metals. Advantages, production methods, and samples are given. *Columbus Coated Fabrics Corp., Columbus 16, Ohio.*

Automatic machines. Brochure describes an automatic rotary spray painting machine and an automatic rotary wiping machine, including specifications, advantages, etc. *Conforming Matrix Corp., 364 Factories Bldg., Toledo 2, Ohio.*

Marking dies. Catalog 146-B describes and illustrates marking with steel dies, and contains information on selection of steel dies for various applications. *James H. Mathews & Co., Inc., 3942 Forbes St., Pittsburgh 13, Pa.*

Bibliography. Authors, titles, and publications in which articles on ethylene-diamine tetraacetic acid appeared are listed in Bibliography (1953-1954). *Geigy Industrial Chemicals, 89 Barclay St., New York 8, N. Y.*

Paste color concentrates. Pamphlet describes a line of paste color concentrates for polyester resins. Types available, pigment concentration, and suggested methods of application are given.



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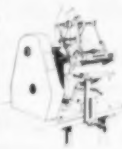

. . . ingredients and other variables are imprinted on plastic bags already preprinted with brand name, trademark. Wholesalers using Markem 45A machines this way can keep up with shifts in retail demand, don't have to maintain large inventories of bags.

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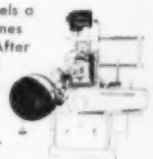

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Packaging. Eight-page booklet gives information on custom-designed and standard packaging specialties produced in transparent and opaque plastics. *Plastic Artisans Inc., Dock St., and Martin Pl., Port Chester, N. Y.*

Epoxy adhesives. Folder lists a line of epoxy adhesives and gives properties and general information. *Furane Plastics Inc., 4516 Brazil St., Los Angeles 39, Calif.*

Hydraulic machinery. Bulletin 110-D describes injection, compression, and transfer molding machines for the plastics industry; extrusion machines for ferrous and non-ferrous metals; metal working equipment; etc. *Watson-Stillman Press Div., Farrel-Birmingham Co., Inc., Aldene Rd., Roselle, N. J.*

Chlorinated paraffin. A 36-page manual describes a chlorinated paraffin for use in plastics, paints, printing inks, rubber, adhesives, mastics, and fabric finishing compounds; lists both resinous and liquid grades available; and reviews their principal industrial applications, properties, characteristics, etc. *Diamond Alkali Co., Chlorinated Products Div., 300 Union Commerce Bldg., Cleveland 14, Ohio.*

Epoxidation - hydroxylation. Bulletin 69 deals with epoxidation and hydroxylation with hydrogen peroxide or paracetic acid. Descriptions of two epoxidation processes—the ion-exchange resin catalyst-fixed bed and the expendable ion-exchange resin catalyst techniques—and a nine-page conversion table are included. Advantages, safety considerations, process equipment, and uses of epoxy and dihydroxy compounds are covered. *Becco Chemical Division, Food Machinery and Chemical Corp., Buffalo 7, N. Y.*

Vertical filters. A line of vertical filters for chemical and water purification are described in Bulletin 111. Included are descriptions of air wash, sluicing, and shaking devices. *Industrial Filter*

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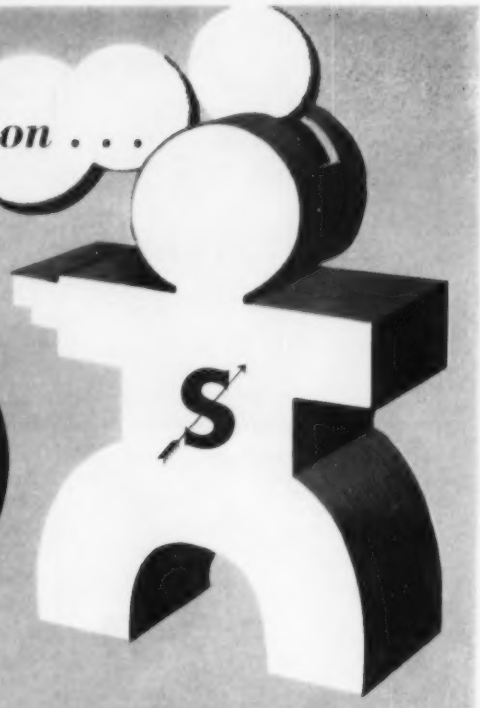

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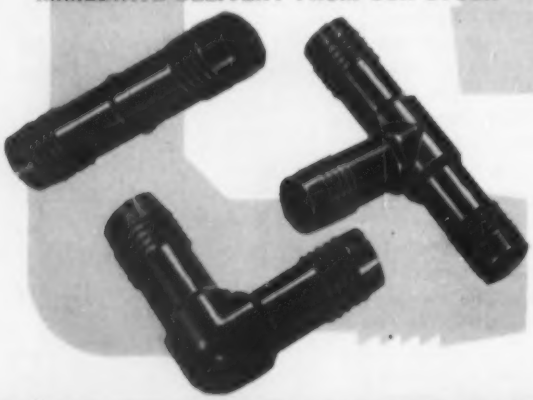

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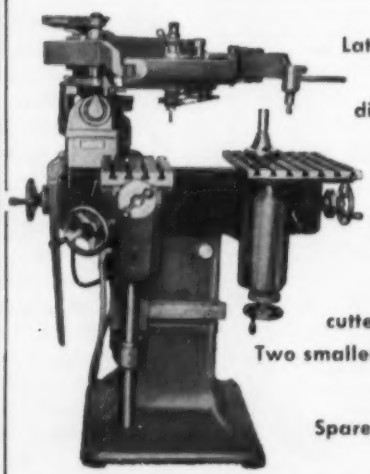

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Emergency chart. New edition of Laboratory Emergency Chart is a condensed, alphabetical compilation listing emergency treatments for specific poisons (as well as treatments for burns, cuts, collapse, toxic headaches, electrical shock, and chemical burns). Available free of charge to established laboratories. *Fisher Scientific Co., 374 Fisher Bldg., Pittsburgh 19, Pa.*

Bag packer. Brochure describes various models of a line of bag packers. Advantages, performance, and descriptions of accessories are included. *E. D. Coddington Mfg. Co., 5026-A North 37th St., Milwaukee 9, Wis.*

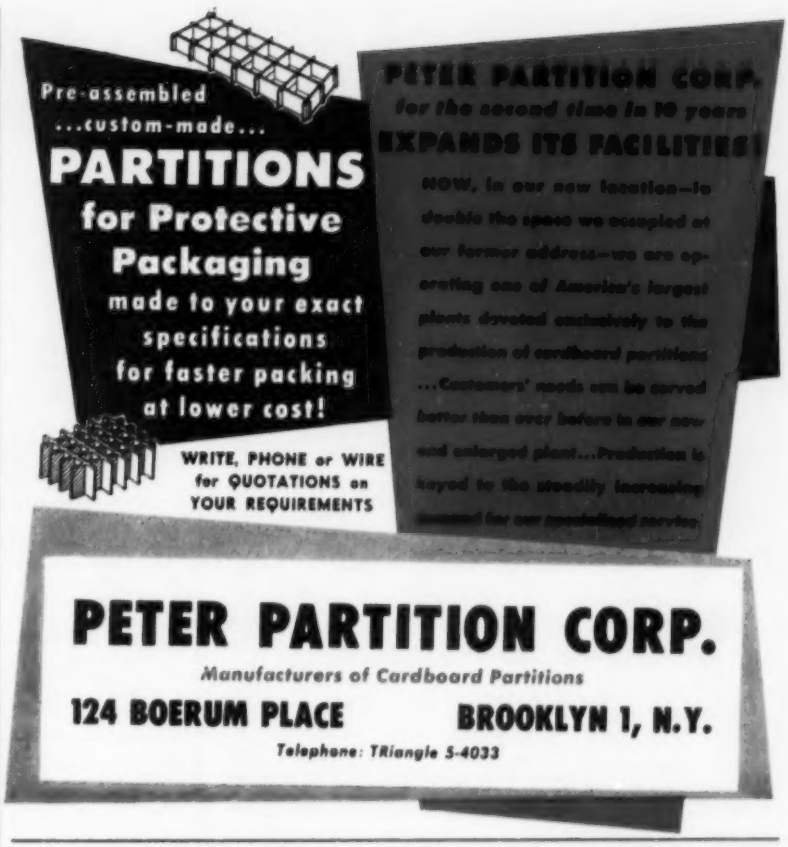
ACIL directory. The 1956 Edition of the Directory of the American Council of Independent Laboratories provides an extensive index of services and facilities in over 400 categories. A geographical listing of members is included. *American Council of Independent Laboratories, Inc., 4302 East-West Highway, Washington 14, D. C.*

Coumarone indene. Bulletin 12-64 discusses a line of para coumarone indene resins. Grades, melting points, color, and physical form are listed. *Harwick Standard Chemical Co., 60 South Seiberling St., Akron 5, Ohio.*

Latices. Bulletin H-20 lists the physical properties, typical applications, advantages, and main suppliers of Hycar latices. *B. F. Goodrich Chemical Co., 324 Rose Bldg., Cleveland 15, Ohio.*

Chemical company. Booklet entitled "Harvest of Research" presents a company's relation to the plastics, paint, rubber, textile, and paper industries. *The Goodyear Tire and Rubber Co., Akron, Ohio.*

Speed reducers. Catalog describes the principles of operation of a line of variable speed reducers. Applications, installation suggestions, and a price list are given. *Revco Inc., Minneapolis, Minn.*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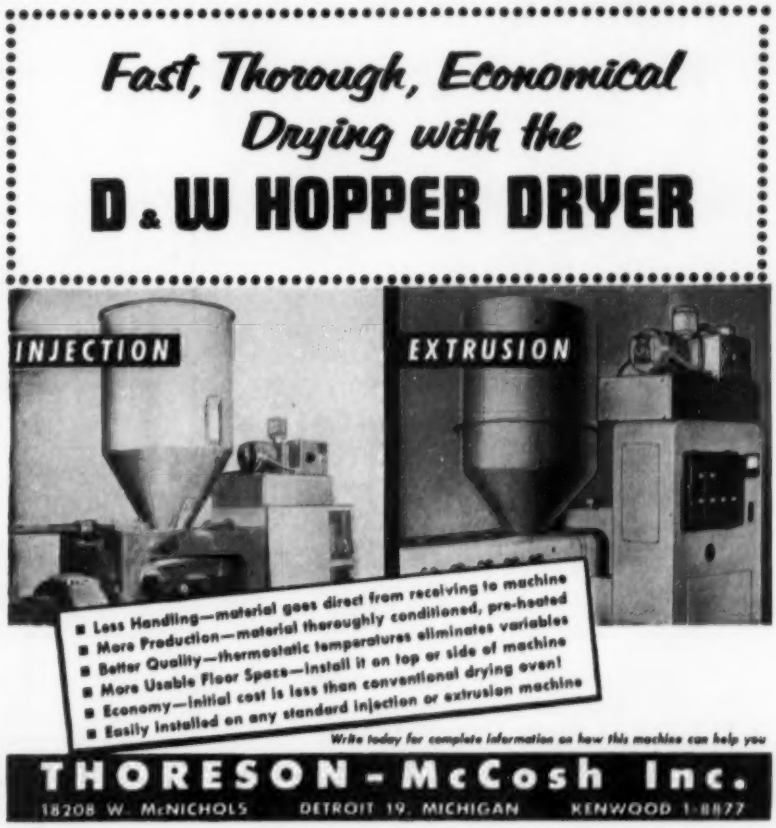
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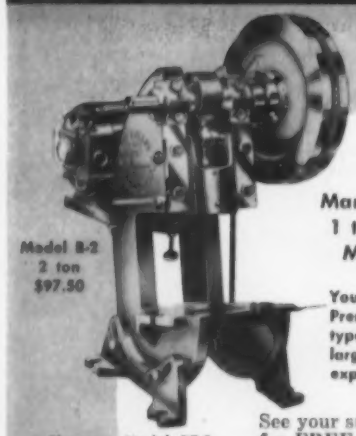
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Sheet, 0.003 gage and over
All other sheets, rods, tubes
Molding, extrusion materials
Nitrocellulose sheets, rods, tubes
Other cellulose plastics
Phenolic and other tar-acid resins:
Molding materials[a]
Bonding and adhesive resins for:
Laminating (except plywood)
Coated and bonded abrasives
Friction materials (brake linings, clutch facings, etc.)
Thermal insulation
Plywood
All other bonding uses
Protective-coating resins
Resins for all other uses
Urea and melamine resins:
Textile-treating resins
Paper-treating resins
Bonding and adhesive resins for:
Plywood
All other bonding and adhesive uses, including laminating
Protective-coating resins
Resins for all other uses, including molding
Styrene resins:
Molding materials[a]
Protective-coating resins
Resins for all other uses
Vinyl resins, total[b]
Polyvinyl chloride and copolymer resins (50% or more polyvinyl chloride) for:
Film (resin content)
Sheeting (resin content)
Molding and extrusion (resin content)
Textile and paper treating and coating (resin content)[c]
Flooring (resin content)
Protective coatings (resin content)
All other uses (resin content)
All other vinyl resins for:
Adhesives (resin content)
All other uses (resin content)
Coumarone-indene and petroleum polymer resins
Polyester resins:
For reinforced plastics
For all other uses
Polyethylene resins
Miscellaneous:
Molding materials[a,d]
Protective-coating resins[e]
Resins for all other uses[f]

* Dry basis designated unless otherwise specified.
** Partially estimated. † Revised.
[a] Includes fillers, plasticizers, and extruders. [b] Production statistics by uses are not representative, as end use may not be known at the time of manufacture. Therefore, only statistics on total production are given. [c] Includes

Production

From statistics compiled by the U. S. Tariff Commission

Preliminary total, 1955†		*January 1956***	
Production	*Sales*	*Production*	*Sales*
18,801	18,918	1,487	1,462
15,855	15,105	1,314	1,200
7,646	7,227	707	586
91,716	90,121	6,492	6,413
4,869	5,100	519	514
5,869	5,431	450	328
211,240	195,630	19,715	17,635
68,546	50,959	5,981	3,913
15,328	16,079	1,510	1,473
25,232	22,084	1,941	1,592
52,453	52,395	5,173	4,788
44,336	36,227	3,479	2,846
27,641	26,753	2,726	2,721
27,787	24,638	2,743	2,495
33,000	28,831	2,882	2,564
42,202	41,134	4,263	4,206
23,674	22,470	2,209	1,930
97,761	92,119	8,768	7,917
28,065	27,618	3,397	2,397
38,410	29,678	3,287	2,458
82,793	80,058	7,774	7,899
422,142	380,810	38,597	33,050
101,712	92,800	9,811	7,765
86,373	85,089	8,405	8,257
701,665	663,556	67,500	63,981
	83,278		8,022
	51,423		4,928
	183,737		16,842
	64,210		6,176
	56,356		5,181
	26,503		2,289
	59,654		6,584
	31,868		3,331
	106,586		10,628
259,632	257,715	21,251	20,151
51,825	44,501	4,163	3,465
3,213	2,596	1,180	1,069
420,191	345,537	42,889	40,068
50,909	46,953	3,921	3,394
4,197	2,661	651	392
81,803	77,783	10,215	9,150

data for spreader and calendering-type resins. [d] Includes data for acrylic, polyethylene, nylon, and other molding materials. [e] Includes data for epichlorohydrin, acrylic, silicone, and other protective-coating resins. [f] Includes data for acrylic rosin modifications, nylon, silicone, and other plastics and resins for miscellaneous uses.

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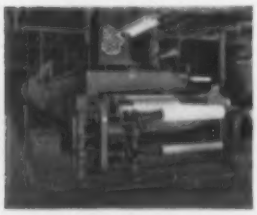

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PLASTIC IMPREGNATED AND COATED MATERIALS
REINFORCED PLASTIC MOLDINGS

Acrylic sheet 14 ft. long is reported to be the largest ever extruded

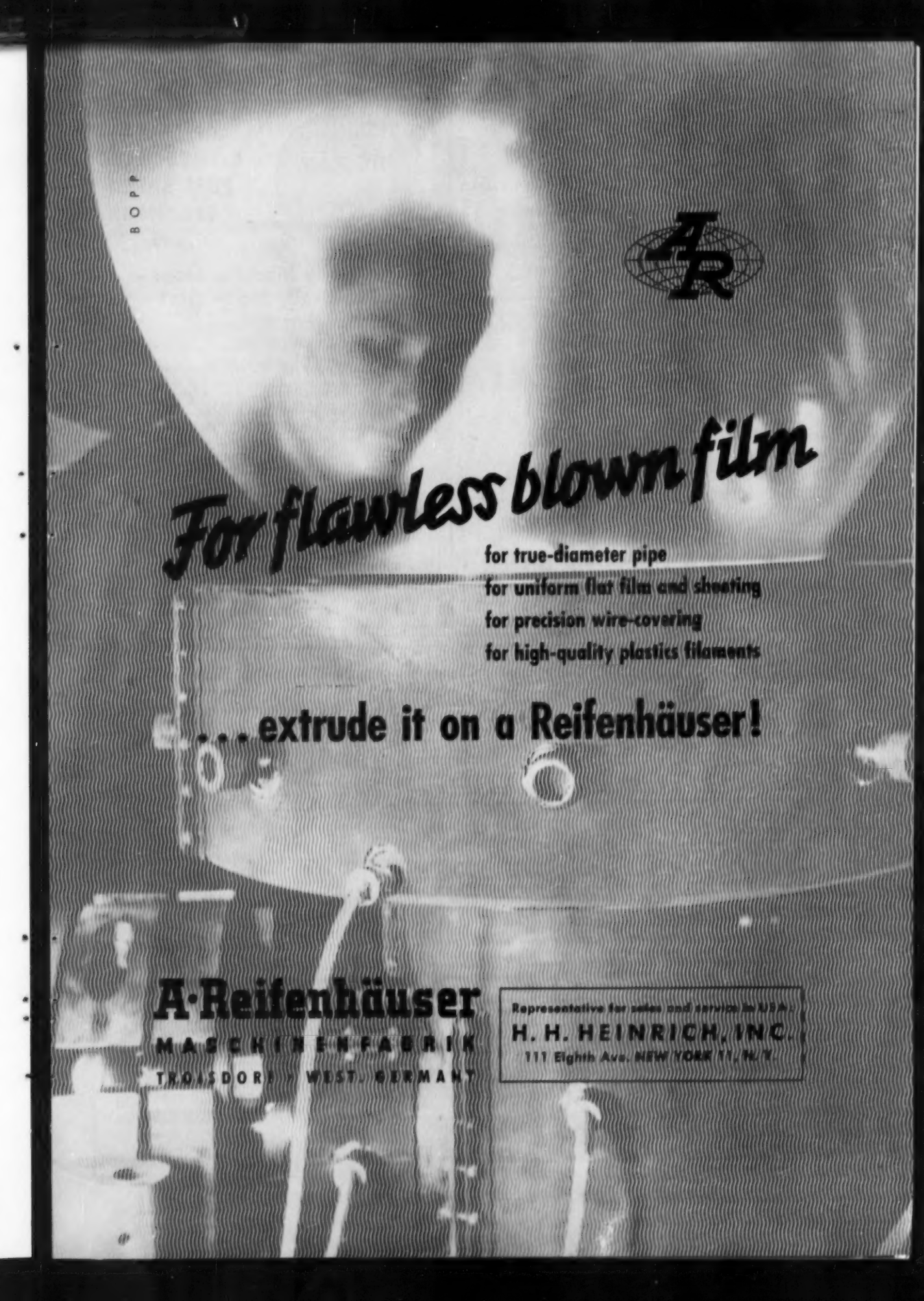
Extruded panels

The use of plastics for outdoor advertising displays and signs will be given added impetus with the successful production of large extruded acrylic panels. Measuring 50 in. wide, 14 ft. long, and 0.125 in. thick, these sheets are claimed to be the largest acrylic panels ever extruded. First application will be in a huge all-acrylic sign being fabricated for a major oil company.

The sign, to be 32 ft. long overall, will be composed of two acrylic sections bolted to a 4-ft. wide aluminum center-frame. Large raised letters and emblems will be formed into the off-white sheets on a hydraulic press. The letters will then be silk-screened in contrasting colors. When mounted, the sign will be backlighted for effective night-time visibility.

In addition to the general advantages that acrylic has to offer —light weight, strength, excellent weather resistance, ease with which it can be formed, light transmitting properties—the extruded acrylic sheets are reported to shrink less than cast sheets when subjected to heat in the forming operation.

Credits: Gerlite sheets extruded for Spangler Sign Works, Phila., Pa., by Gering Products, Inc., Kenilworth, N. J.; acrylic supplied by Du Pont, Wilmington, Del., and Rohm & Haas Co., Phila., Pa.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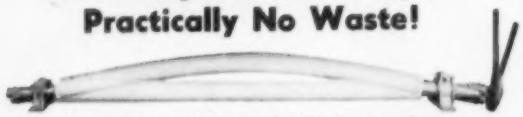

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Models Available For Every Situation—

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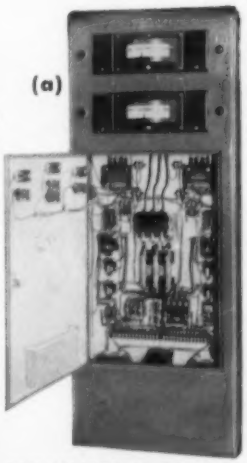
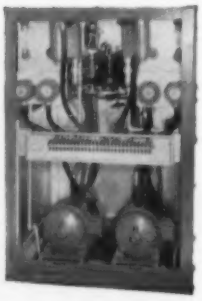
- **THERMOLATOR FOR MULTIPLE MOLDS**—Model C-3, with individual tanks, pumps, and controls for each of 3 mold sections.
- **MODEL H AUTOMATIC THERMOLATOR**—Shown at right. Completely automatic operation, for permanent installation. Controls can also be integrated in Master Instrument Control Panel with other press and mold controls by instrument manufacturer, affording most efficient supervision.

Model H THERMOLATOR is manufactured under U.S. Pat. 2,632,088, and is built to conform to JIC standards.

(a)



(b)



THERMOLATOR Model H includes Control Cabinet (a); and Operating Unit (b) for permanent installation.

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Plastic Molders Engineering Co., 55 E. Washington St., Chicago, Ill.; IN CANADA: Richardson Agencies, Ltd., 18 Holly St., Toronto 12, Ont.; FOR EUROPE: Merac, Inc., 44 Rue La Boetie, Paris (8E), France.

Polyethylene clip

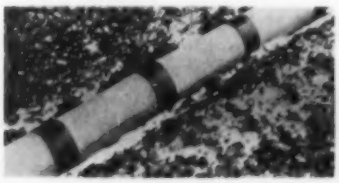
A molded flexible polyethylene device which clips over the open joint between sections of drain pipes used in sewage disposal systems has solved the problem of keeping soil and stones from working their way into the system.

The function of the clay drain pipe is to carry away excess surface or ground water from an area not sufficiently drained by natural means, or to disperse into the soil the liquid waste from private sewage disposal systems. To assure efficient dispersal or collection, it is necessary that the sections of the pipe be spaced about ⅜ in. apart and that the top and sides of this open area (the bottom half is left open) be covered with a protective wrap.

The 2½ in. wide molded clips have proved far more effective for the job than the tar paper wrapping previously used. The tough clips will resist the moisture, acids, and alkalies found in the ground. To simplify installation, a fin molded into the top of the flexible clip serves as a handle for snapping it into place. Lugs molded into the inside of the clip provide the proper ⅜-in. spacing and the clips themselves will absorb any linear expansion without damage to the pipe.

Credits: Polyethylene clips are distributed by Boco Industries, Inc., Detroit, Mich.; molded by Mayfair Plastics, Inc., Detroit, Mich.; polyethylene supplied by Bakelite Co.

Molded-in lugs (above) on polyethylene clip insure proper spacing between sections of pipe (below)



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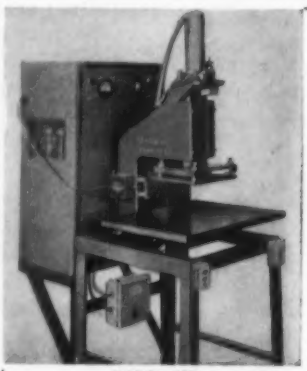

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Pothead cover

A dip molded vinyl plastisol cover for lead-in wire terminal connections for outdoor potheads is designed to eliminate the need for extensive electrical taping, to reduce installation time, and to prevent the possibility of flashovers which frequently occurred when snow or rain seeped into the connections under the ordinary electrical tape which was previously used to protect the terminals.

The strong, flexible cover has excellent dielectric strength and resists the effects of sun, rain, heat, and cold. To install, terminal leads are merely slipped through the two openings in the bottom of the trouser-shaped plastic cover and then attached to the electrical posts in the pothead. The vinyl cover is held securely in this position by wrapping electrical tape around the two loose ends.

The cover is made by dipping an aluminum form heated to a predetermined temperature into a liquid vinyl plastisol compound. After being withdrawn from the compound, the plastisol that has adhered to the form is removed simply by slitting it along the bottom and peeling it off the aluminum form.

Credits: Vinyl cover developed by Steere Enterprises, Inc., Akron, Ohio, in cooperation with The Cleveland Electric Illuminating Co., Cleveland, Ohio. Geon vinyl resins supplied by B. F. Goodrich Chemical Co., Cleveland, Ohio.

Vinyl cover (inset) for pothead is easily installed

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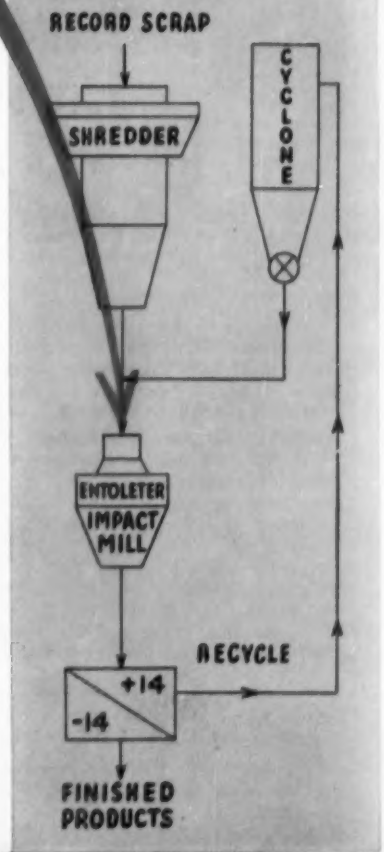
New "Entoleter" Impact Mill applications are being developed continually in our laboratory in New Haven. Contact us today about your grinding system problem!



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— SAYS MR. DICK BURNHAM
of B. W. Molded Products Company, Pasadena, California.

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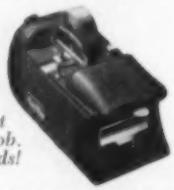

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Light switch

Polyethylene, phenolic, melamine, and urea all contribute to the design of a new type of rotational light switch that glows in the dark and turns current on and off by being turned to the right and left instead of up and down.

The cover, switch body, and turn knob for the device are all molded of thermosetting materials chosen for their heat resistance. The flat cover is molded of urea either in brown or ivory; the switch body, which is located behind a rectangular opening molded into the cover, is phenolic; the turn knob which fits into the switch body and projects out through the rectangular opening, is molded either of phenolic or melamine.

To achieve the "glow-in-the-dark" effect, a molded polyethylene boot, into which a fluorescent pigment has been incorporated, is force-fit over the end of the turn knob that projects through the opening. A few seconds' exposure to any source of light charges the boot so that it will remain visible throughout the night.

Luminescent polyethylene in switch glows in dark

Credits: Roto-Glo switch manufactured by Pass & Seymour, Inc., Syracuse, N. Y.; phenolic supplied by Monsanto Chemical Co., Springfield, Mass., and Durez Plastics & Chemicals, Inc., N. Tonawanda, N. Y.; urea and melamine supplied by American Cyanamid Co., New York, N. Y.

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MANUAL ON "MYCALEX." 24-page manual presents detailed information on "Mycalex" glass and mica compound for compression or transfer molding. Gives properties, performance curves, design data, machining tips and case histories of specific applications. General Electric Company. (E-601)

SHORT-RUN CUSTOM MOLDER. Booklet pictures and describes thermoplastic and thermoset molding facilities of Minnesota custom molding firm that specializes in the production of low-cost molds for short runs. Dayton Rogers Manufacturing Company. (E-602)

DRY COLORANTS FOR POLYSTYRENE, POLYETHYLENE. Brochure describes company's prelubricated dry colorants for styrene and polyethylene that can be used without wetting agents. Sample chips of colored plastics are also offered. Riverdale Color Company, Inc. (E-603)

MULTI-PURPOSE ADHESIVE. Literature describes and gives step-by-step instructions for using "Resiweld" transparent adhesive, designed to bond strongly an extensive variety of metals and plastics to themselves and to each other. H. B. Fuller Company. (E-604)

HYDRAULIC PRESSES. Illustrated literature lists detailed specifications and dimensions of line of 4-column, down-acting hydraulic presses with from 25 to 200 tons capacity. Hydraulics Division, K. R. Wilson Incorporated. (E-605)

HOW TO USE ELECTRIC HEATERS. 30-page illustrated booklet describes and diagrams 101 uses for company's chromalox strip, ring, tubular and cartridge heaters, used in industrial processing operations. Edwin L. Wiegand Company. (E-606)

DIAMOND POLISHING COMPOUND. Folder lists specifications and prices for "Diadem" diamond-powder polishing compound, suitable for finishing mold surfaces; supplied in unbreakable polyethylene "squeeze" tubes. Whittaker, Clark & Daniels Incorporated. (E-607)

PLASTIC WELDING HAND-TOOL. Illustrated literature describes, gives specifications for lightweight electric plastic welder for thermoplastic fabricating that employs heating element and compressed air. Seelye Craftsmen. (E-608)

CUSTOM HEAT SEALING. Brochure describes facilities and lists services of eastern custom heat sealing and vacuum forming organization. Aquador Plastics. (E-609)

AUTOMATIC WEB EDGE GUIDE. Illustrated brochure describes automatic air-actuated edge guide, suitable for use on film and sheeting processing equipment. Unit has stated accuracy of ±.012 in. on webs having "wander" of ±¾ in. per 100 in. of length at 750 ft./minute. Web Controls Corp. (E-610)

OVENS FOR PLASTICS PREHEATING. Illustrated bulletin describes in detail company's line of preheating and drying ovens for use in molding, extruding, and forming operations. Prices included. Despatch Oven Company. (E-611)

SLAT EXPANDERS. Bulletin explains how company's anti-wrinkle slat expanders are used to eliminate wrinkles from plastics films by applying a smoothing, spreading action during continuous roll operations. Progressive Machine Company, Inc. (E-612)

MOLDS FOR VACUUM FORMING. Brochure describes the uses and special features of 3 types of vacuum forming molds made by this manufacturer: plaster, resin, and sprayed metal. Rules of thumb for price estimating are included. Metalmold Forming Co. (E-613)

SAWING AND GROOVING OF PLASTIC SHEET. Bulletin describes and gives performance data on a machine used for sawing, grooving, and multiple cutting of large sheets of plastic. Variety of accessories suit the machine for many fabricating operations on plastics sheet and laminates. Mereen-Johnson Machine Co. (E-614)

HEATING CYLINDERS. Catalog describes company's line of replacement cylinders, heater bands and adapters for all makes of injection presses. Detailed instructions on installation, operation, and maintenance of superheaters is included. Injection Molders Supply Co. (E-615)

ELECTRONIC SEALING MACHINES. Illustrated literature describes line of electronic heat sealers and generators; includes 2-post, 4-post, and guillotine presses, a 250 watt rotary sealer, and generators from 1 to 12 kw. output. Mayflower Electronic Devices, Inc. (E-616)

IMITATION GOLD FOIL. Folder contains working samples and mentions applications for imitation gold foil, used in hot die stamping. Ralph W. Grauert, Inc. (E-617)

NAMEPLATE & PARTS MARKING MACHINE. Brochure covers five models of the Acromarker for deep penetration marking of hard and soft metallic and non-metallic materials. Includes special fixtures for handling odd shaped parts. Acromark Company. (E-618)

WEB EDGE POSITION CONTROL. Bulletin describes mechanism for controlling the edge position of plastic film and sheeting webs. Askania Regulator Co. (E-619)

CERAMIC RADIANT HEATER. Illustrated literature describes and lists specifications for ceramic-base radiant heater with Michrome heating elements having temperature range from 300°F to 1400°F. Also describes several actual plastics applications. Radiant Heat Enterprises Incorporated. (E-620)

VARIABLE SPEED ELECTRIC DRIVE. 12-page illustrated brochure shows many actual installations using company's "VS-Jr." drive motor, available from ¾ to 3 h.p.; drive uses no mechanical connecting devices and features smooth starting and stopping; stepless adjustable speeds; "plug-in" operation. Reliance Electric & Engineering Company. (E-621)

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A COMPONENT OF SYNTHETIC RESINS. 12 page technical booklet describes glycolonitrile ($HO\text{-}CH_2\text{-}CN$), a chemical with applications in the production of a laminating thermosetting resin used by laminators and as a curing agent for epoxy resins. American Cyanamid Company. **(E-630)**

CUSTOM FABRICATED INSTRUMENT PANELS. Illustrated folder describes vinyl lamination edge-lighted instrument panels custom fabricated by this company. G. Felsenthal & Sons Inc. **(E-631)**

FORMABLE PVC MATERIAL. Bulletin describes properties and specifications of "Seilon FH1" formable PVC calendered rolls and sheets and pressed sheets. Plastics Divisions, Seiberling Rubber Company. **(E-632)**

VINYL AND STYRENE RESINS. 6 page brochure discusses and illustrates various uses for company's "Pliovic" vinyl resins and "Plio-tuf" high impact modified styrene resins. Typical properties of "Plio-tuf" sheeting are listed. Chemical Division, The Goodyear Tire & Rubber Co. **(E-633)**

BETA GAUGE FOR FILM AND SHEETING. Illustrated folder describes company's "BG-5" beta gauge for measuring, recording and controlling variations in the weight or thickness of sheet materials by means of a beam of beta rays. Tracerlab, Inc. **(E-634)**

CUSTOM INJECTION MOLDER. Illustrated brochure describes facilities of this large eastern custom molder of plastics and rubber; facilities include a testing laboratory, a pilot plant, and 20 presses. Vulcanized Rubber & Plastics Company. **(E-635)**

CATALOG OF ADHESIVES. Eight-page catalog describes characteristics, bonding process and suggested uses for "Cordo-Bond" adhesives, available in various formulas for the bonding of plastics to a wide range of materials. Cordo Chemical Corporation. **(E-636)**

INSULATING BASE FOR PRINTED CIRCUITS. 8-page technical booklet discusses the use of "R,M-2035," a moldable phenolic-impregnated epoxy-coated cellulose fibre sheet material, as an insulating base for molded printed circuits. Rogers Corporation. **(E-637)**

CUSTOM LAMINATOR. 8-page illustrated booklet describes the facilities and products of this New England custom laminator. Services include reinforced plastics and sandwich board constructions. Keller Products, Inc. **(E-638)**

PLASTICIZERS. Booklet lists detailed technical data on six plasticizers, including specifications, physical and chemical properties, and data on solubilities and compatibilities. Barrett Division, Allied Chemical and Dye Corporation. **(E-639)**

HIGH-PRESSURE LAMINATES. 24-page illustrated booklet describes, lists properties and specifications of extensive line of "Synthane" sheet, rod, and tube materials. Discusses fabrication techniques and presents some typical applications. Synthane Corporation. **(E-640)**

WEIGH FEEDER FOR INJECTION PRESSES. Illustrated brochure describes company's weigh feeder that is mounted above injection press and feeds precise, predetermined quantities of plastics materials to the press. The Exact Weight Scale Company. **(E-641)**

POLYETHYLENE RESINS. 12-page booklet outlines uses and describes physical, chemical, electrical and thermal properties of "Tetrothene" polyethylene resins. U. S. Industrial Chemicals Company. **(E-642)**

ELECTRICALLY HEATED EXTRUDER. Illustrated literature shows floor plan, lists specifications for company's "Model 50" 3½ in. electrically heated extruder with nominal rated capacity of 125 to 150 pounds per hour. National Rubber Machinery Company. **(E-643)**

POLYESTER RESINS. File folder contains technical data sheets listing properties, uses and other information on company's line of eight "Stypol" polyester-base resins for casting, potting and dip-coating applications in the electrical field. H. H. Robertson Company **(E-644)**

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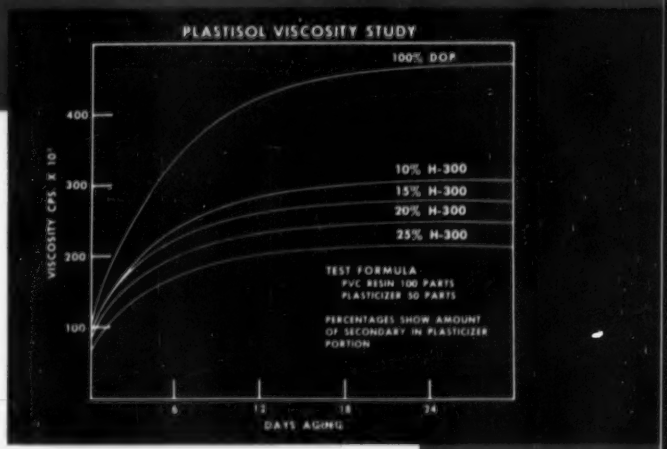

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Try it! Mixtures containing Conoco H-300 are characterized by lower initial and aged viscosities. Viscosity build-up is retarded and reaches a maximum after approximately one week. Since build-up is proportional to the percentage of Conoco H-300 used, formulators can efficiently predict and control the viscosity of finished batches. Cost wise as well as quality wise, the "extender of profit" merits your consideration. Conoco H-300 can be used to the extent of 25% of the total plasticizer required.

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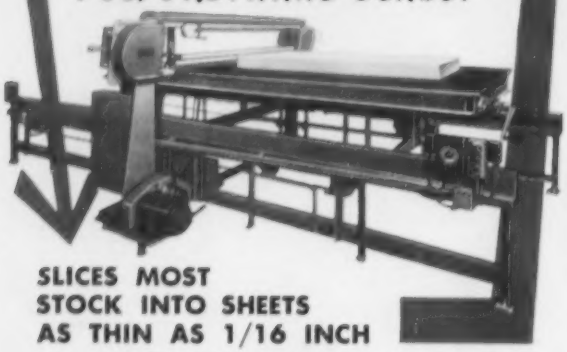


SLICES MOST STOCK INTO SHEETS AS THIN AS 1/16 INCH

Yes, with FEMCO'S new Polyurethane Leveling and Splitting machine you can easily reduce bulky polyurethane into thin sheets. Save by buying slab polyurethane and fabricating it yourself. And this one-man operated machine is a real labor saver, too!

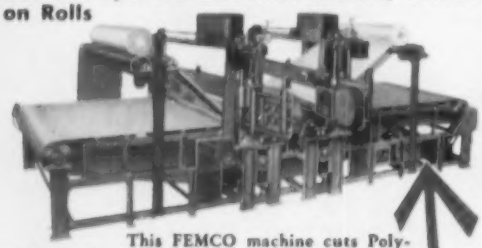
"PUSH BUTTON" OPERATION

After machine levels the slab, operator, from "unload" position, pushes a button. The table glides back and forth and the cutting blade does the rest. The table automatically raises and lowers to clear the cutting blade on the backward movement, then indexes to required thickness before the forward movement.

Available in these table sizes: 45" x 64"; 45" x 84"; 64" x 84"; 64" x 96"; 84" x 110".

Wire, write, or call for details.

DOUBLE-HEAD POLYURETHANE SLAB-CUTTER Splits Stock Into Sheets, Winds on Rolls



This FEMCO machine cuts Polyurethane slabs into sheets (1/16" if desired) and then winds the sheets into rolls, easy to ship or fabricate. Handles slabs 84" wide and 25 feet long *(to 100 feet long when power conveyors are added.)*

With the "two-way" or double-head action of the cutter, stock is cut on both forward and backward movements of the conveyor belt; cutter automatically indexes to meet the stock, which is rolled up at each end of the machine. A slab of polyurethane may be split and rolled in minutes. Wire, write, or call us for details and photos.

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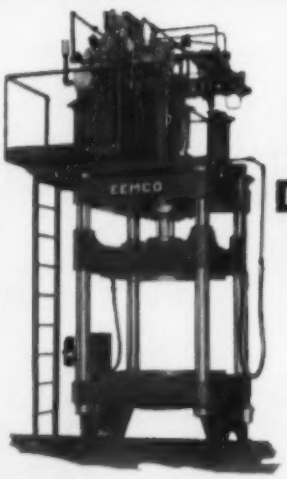

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- PREFORM MACHINES
- ROVING CUTTERS
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EEMCO **ERIE ENGINE & MFG. CO.**

12th ST. & East Ave., ERIE, PA.

Partition assembler in operation. Cardboard partitions are gripped by needles and automatically rotated to position for cross pieces

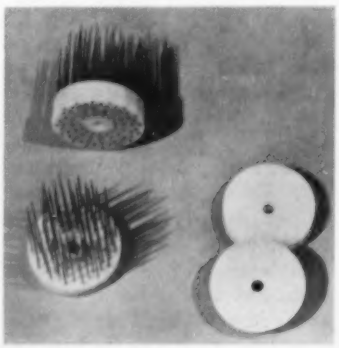
Nylon disks in assembler device

Molded nylon disks, in which up to 80 steel needles have been imbedded, help speed up the operation of an automatic device for assembling corrugated board box partitions. Using the nylon disks, the machine with only one operator can perform the assembly job formerly requiring the efforts of eight people. In addition, the use of nylon results in important reductions in the weight of the machine and, consequently, in its power requirements.

The assembler device consists basically of a rotating platen on which 141 of the nylon disks have been mounted. Segments of the corrugated board are fed to the machine by two hopper-type tables which move hydraulically in a vertical plane. One table feeds pieces in one direction to the platen where they are gripped and held securely in place by the needles imbedded in the disks. As the platen then rotates through 90° to a new position, cross pieces are driven home by a second table. After assembly is completed, a wiper plate forces the partitions off the needles and drops them onto a conveyor belt.

Because of the great dimensional stability and resilience of nylon, the needles remain imbedded in the disks over an extended period, even when the machine is used continuously. It has been estimated that up to 25 lb. of corrugated board can be fitted together per minute. The machine can be modified in a matter of minutes to accommodate various patterns in which pieces and cross pieces of corrugated board can be assembled.

Credits: Automatic partition assembler manufactured by Huntington Industries, Inc., Meadowbrook, Pa.; Zytel nylon resin supplied by Du Pont; molding by West Co., Phoenixville, Pa.



Needles imbedded in nylon grasp cardboard sections

For permanent type

KEL-F® fluorocarbon plastic

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KEL-F plastic printing inks offer the electrical industry a new permanent type medium for color-coding wire and marking, striping and printing non-adhesive surfaces. Based on the uniquely stable trifluorochloroethylene polymer, these inks are inherently resistant to corrosive conditions, abrasion and heat. Combining with the substrate, they form an effective bond with nylon, KEL-F plastic and other plastic materials.

KEL-F plastic printing inks are produced in two types:

AIR-DRYING SERIES—formulated with a permanent fluorocarbon resin binder to adhere to a variety of plastics and rubbers.

HEAT-SETTING SERIES—designed to withstand solvent or chemical attack. Conductive silver formulation especially suitable for printed circuits and other electronic applications.

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Green	Brown	Red
Yellow	Grey	Conductive silver
Orange		

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Incorporating battery-powered motor, lights, and horn, reinforced plastics toy car is 6 ft. long, 28 in. wide, weighs 150 pounds

Miniature car made of reinforced plastics

Latest in the growing list of toy autos that are scaled-down replicas of popular life-sized models is the reinforced plastics Junior Star Chief. Intended for use in dealer promotions, the child-size auto duplicates the body shell of the 1956 Pontiac Star Chief convertible right down to the most minute detail and is realistically equipped with a battery-powered motor, and brakes, gearshift, horn, steering wheel, and head and tail lights.

The epoxy-fibrous glass master mold for the toy auto is made from a clay model. Ten or more sets of duplicate molds—also made of epoxy-fibrous glass laminate—are then produced from the master mold for actual production line use. Because of the complexity of the toy auto, the molds are divided into five separate sections—front, rear, two sides, and top. During production, these five parts are clamped together to form a complete mold.

The interior of the mold is then coated with a release agent and the fibrous glass material is laid up in strips. After impregnating the fibrous glass with liquid polyester resin, the vacuum bag technique of molding is used. Heat lamps are used to harden the resin and the molded body is removed in one piece from the mold by taking apart the various sections. A trimming fixture, with precise locator pads, holds the molded body shell in position for easy trimming of rough edges.

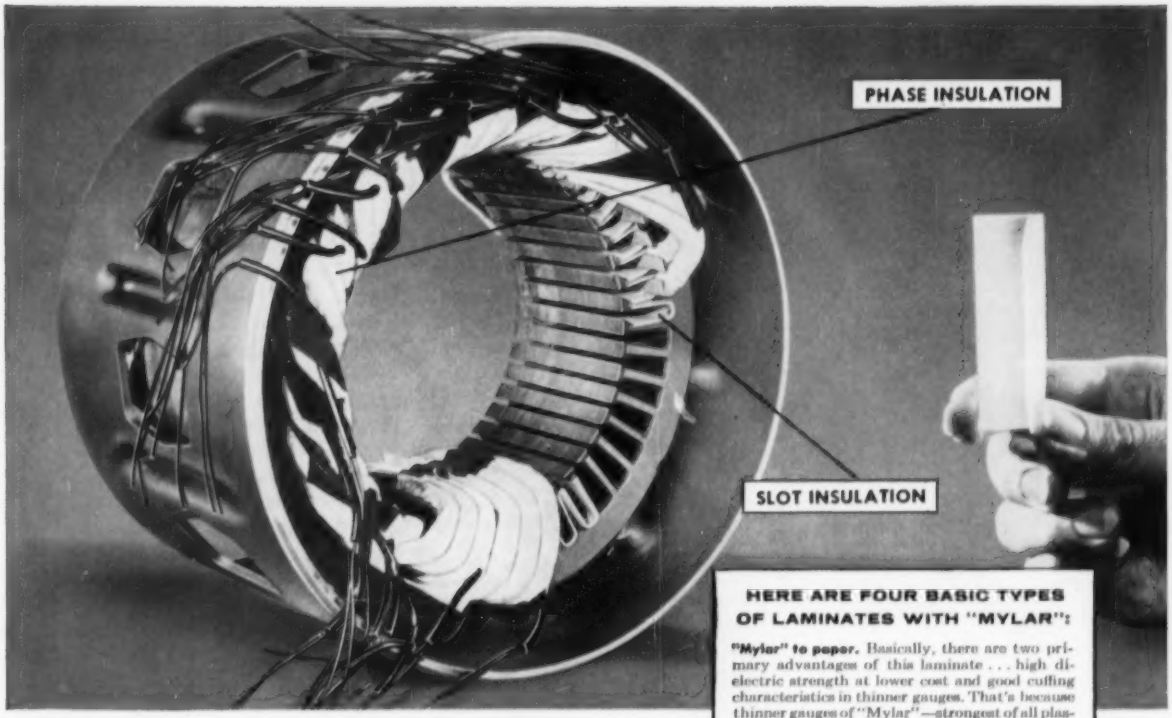
The body shell is then attractively painted in a blue and white two-tone color combination. A 12-v. battery-operated motor which drives the car at a maximum speed of 8 m.p.h., is then installed. A gear shift lever, which actually shifts from neutral to forward or reverse positions, a steering wheel, buttons to operate the horns and lights, and semi-pneumatic tires complete the assembly.

Credits: Epoxy resins compounded by Rezolin, Inc., Los Angeles, Calif., using epoxy resin supplied by Bakelite Co., which also supplies the polyester resin; fibrous glass supplied by Owens-Corning Fiberglas Corp., New York, N. Y.; body shells are produced by Modern Pattern and Plastics, Inc., Toledo, Ohio; accessories are assembled by Silvestri Art Mfg. Co., Chicago, Ill.

Fixture holds plastic shell in position during trimming

Now available—a complete line of improved insulating laminates with

Du Pont MYLAR®



Du Pont "Mylar"* polyester film is now available for a wide variety of electrical insulating uses, some of which are illustrated above. These laminates offer superior performance . . . make possible important space savings. That's because laminates with "Mylar" provide exceptionally high dielectric strength and heat stability . . . plus remarkable resistance to moisture and many chemicals.

While those types listed on the right are basic, there are numerous other combinations of "Mylar" available, depending on specific needs. So check your supplier today. It will pay you to investigate the new combinations of "Mylar" in his line. Or send in the coupon below for names of converters who manufacture electrical laminates with "Mylar". Be sure to mention the specific application you have in mind.

HERE ARE FOUR BASIC TYPES OF LAMINATES WITH "MYLAR":

"Mylar" to paper. Basically, there are two primary advantages of this laminate . . . high dielectric strength at lower cost and good cuffing characteristics in thinner gauges. That's because thinner gauges of "Mylar"—strongest of all plastic films—can be used.

"Mylar" to glass cloth. Because "Mylar" remains dimensionally stable from −60° to 150° C., "Mylar" laminated to glass cloth offers superior insulation at both high and low temperatures. In addition to high flexibility, this laminate has good forming characteristics in thinner gauges.

"Mylar" to asbestos. Excellent for motors and generators operating in the Class "B" temperature range. Coated asbestos laminated to this tough polyester film produces a stronger product with increased moisture resistance.

"Mylar" to mica. This laminate offers *maximum* insulation plus flexibility. In short, mica is easier to work with when laminated to "Mylar". Costs are lower too because thinner gauges of mica can be used . . . Du Pont "Mylar" gives the mica "body."

*Du Pont manufactures the basic material "Mylar"—not finished electrical laminates. "Mylar" is Du Pont's registered trademark for its brand of polyester film.

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DU PONT ® MYLAR POLYESTER FILM

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Please send your new booklet (MB-5) featuring "Mylar" polyester film in motors plus names of converters who manufacture laminates with "Mylar".

Application_____

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Firm_____

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Wood flour is usually a high percentage of the finished product. But it's a *small* percentage of the *value* of the product. So quality and uniformity are the prime considerations in wood flour.

The new Wilner wood flour mills were engineered to provide the highest precision and automation in processing control. The plants are so completely automatic, they could be operated by pushbutton from the president's office. Continuous moisture and rotap testing guarantees that the flour, once tailored to the mix or formulation, never varies. The user is assured of wood flour milled from kiln-dried, clear white pine, free from contamination, with a low moisture content, and in any mesh size desired.

Typical Analysis
140 Mesh Wood Flour

Thru	On	
	100	trace
120		99.2
140		96
170		86
200		75.6
270		49.2

Uses of Wood Flour

Wood flour is a *filler* and *extender*, adding strength, bulk, lightness and impact resistance to other more costly materials, such as plastics, linoleum, roofing felt, molded rubber products, wall board and vinyl floor coverings. It is an *ideal absorbent* for explosives, adhesives, rug and fur cleaners, stock feeds, and fertilizers (with built in insecticides?), and an *effective mild abrasive*, for cleaning metal surfaces, such as molds.

Other prospective uses include very fine filtration work; as a *binding agent* and *moisture absorbent* in ore processing; as an *anti-binding agent* to give desired porosity after burn-out in products like firebrick.

For samples, further information and specifications, please write:

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Wilner Wood Products Co., Norway, Me.

Around the world

(*From page 105*)

closely with the Australian concerns to build up raw material sources. Australians are now no longer entirely dependent upon imports. Licenses from the U. S. are difficult to obtain because of the dollar shortage. Technical knowledge is the commodity most in demand.

One of the steps being made to meet these needs was the recent formation of Freighters-Lunn Industries, Ltd., in Adelaide—a joint venture by Freighters, Ltd. of Melbourne, and Lunn Laminates, Inc., Huntington Station, N. Y., to manufacture reinforced plastics auto body parts, buses, trucks, and a number of other articles. Another licensing agreement exists between Filon Plastics Corp., El Segundo, Calif., and a British firm well established in Australia, to produce fibrous glass-reinforced plastic corrugated sheeting "down under." Reinforced plastics safety helmets of all kinds will be produced through technical assistance from E. D. Bullard Co., San Francisco, Calif.

Indonesia and Singapore

In Indonesia I found a people consuming probably not more than 2 oz. of plastics per capita per year. This new republic has a population over 80 million. Since most of the Dutch and English executives and supervisory personnel have left the country, Indonesia is in dire need of skilled technicians. The people there are very ambitious and eager to learn manufacturing and management techniques. Because of the tropical climate, heavy rainfalls, etc., plastics products with their non-corrosive, durable qualities can play a big role.

Indeed, corrosion is a basic problem in all tropical lands. This fact, coupled with the presence of termites and other insects, creates a big opportunity for plastics in countries with warm and humid climates.

Singapore is an important trade center and should not be overlooked by American plastics firms. The question of providing dollars is not difficult, as any amount can be acquired at relatively low premium. Singapore's population is more than 75% Chinese, and its plastics factories are all small and all Chinese owned. Their equipment is mostly manufactured in Hong Kong, and most presses are hand-operated. The largest volume in plastics manufacturing in Singapore is in extruded pipes. Vinyl and styrene are the materials most in use.

India

Calcutta, a combination of splendor and squalor, fabulous wealth and horrible poverty, has had its prewar population of three million doubled by an influx of religious and national refugees from outlying districts. Calcutta is one of the major plastics centers in India. Recently it has become possible to export raw materials from the United States to India.

The plastics industry as a whole in India has been served mostly by English suppliers. Very recently, imports have arrived from Italy and, in increasing amounts, from Germany. The latter are mostly in the form of semi-finished products especially designed for the Indian market. Extremely cheap Celluloid is being imported in growing quantities from Japan. The respect in which American production methods and American materials are held, will help in this situation.

According to Dr. Gupka, publisher of *Indian Plastics News*, and one of the leading industrialists, everyone expects the injection molding business to expand greatly in the near future, especially in view of the two new plants being erected in India, one of which will produce polystyrene, the other polyethylene.

Pakistan

Pakistan, a new country, was a picture of vigor and aggressiveness, of hard working people, and of a big promise of higher standards of living. The former Pakistan Ambassador to Washington, Mr. M. M. Ispahani, then Minister of Commerce and Industry, who was my host, pointed out that the inherent aggressiveness of the Moslems, which helped them gain political independence, is the underlying factor in their all-out effort to improve their national

U.S.I. POLYETHYLENE PROCESSING TIPS

Vol. 1, No. 3

Reduce Warpage in Injection Molding

Injection molded polyethylene articles frequently have a tendency to warp — especially if they are large and flat. While this is not serious in many cases, warpage of certain items such as container covers and drainboards presents a definite and sometimes difficult problem.

How can warpage be corrected? There is no single clear-cut solution to all cases. The problem can be solved by reducing the internal stresses that are set up in a molded part during cooling, and this may be done by adjusting mold conditions, changing to another resin, redesigning the mold, or a combination of these changes.

Molding Conditions Can Be Adjusted

Pressure should be held as low as possible. This allows some of the internal stresses to be relieved. Of course pressure must be kept high enough to avoid short shots.

Stock temperatures should be kept high to kill the elastic memory of the resin. This avoids those stresses that might otherwise be created by elastic memory.

Molds should be kept warm. Most of the internal stresses that cause warpage come from uneven cooling. By cooling slowly this effect is minimized.

Mold should be filled as rapidly as possible so that the entire part can be cooled at about the same rate.

OPERATING CONDITIONS FOR MINIMUM WARP

Molding Condition	Min. Warp
Pressure	low
Mold Temp.	balanced and warm
Stock Temp.	high
Gating Temp.	low
Injection Speed	high
M. I. of Resin	high

Mold Design For Minimum Warpage

Mold cooling should be concentrated around the gating where resin temperature is highest. With more cooling at the hottest point, temperature of the entire part can be reduced evenly with a minimum of internal stress.

Other mold design features are important too, especially the location of the sprue. The many other factors involved cannot be described here, but U.S.I. Technical Service personnel will be glad to discuss any individual situation.

Proper Resin Selection Can Decrease Warpage

Higher stock temperature and lower prescure can solve warpage problems, but they can create problems too, such as reduction of production rate. This can be compensated for by choosing resins with higher flow characteristics, such as PETROTHENE® 202 (M.I. = 22) or PETROTHENE® 203 (M.I. = 8).

These resins flow faster at lower pressures, so the lower pressure can be used without taking a production penalty. And the elastic memory of these resins can be killed at lower temperatures, so the machine can be operated with lower barrel temperature.

How much effect does a higher flow resin have on molding pressure and resin temperature? These rules of thumb apply in most cases.

1. Injection pressure can be reduced by approximately 25% when the resin melt index is doubled; assuming, of course, the same mold fill, cycle time and injection pressure.

Example:	M. I.	Pressure
Original Resin	2	1,000 psi
	4	750 psi
Other Resins	8	560 psi

Injection temperatures can be reduced by approximately 70°F when the resin melt index is doubled. This assumes the same fill, cycle time and injection pressure.

Example:	M. I.	Temperature
Original Resin	2	500°F.
	4	430°F.
Other Resins	8	360°F.

U.S.I. Offers Technical Assistance

The combination of machine conditions, mold design, and resin selection described above can result in a product with minimum warpage. But this combination may not be the best for optimum production rate, shrinkage, mold release, stress crack resistance, etc.

These other factors will be discussed in more detail, in future articles in this series, but if you have a particular problem now, why don't you call on U.S.I. now. Our Technical Service personnel will be glad to work with you toward finding a solution.

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economy. The principal plastics manufacturers are well equipped, as most of the factories are only a few years old. They are most active in the field of injection molding. The variety of items produced is still small, as it is difficult for them to obtain molds. Some extrusion is being done, as well as compression molding of electrical parts. Vacuum forming was of great interest to manufacturers, and two large companies are studying reinforced plastics.

There has been in Pakistan an accidentally vicious cycle in the exchange situation. Even the existing plastics processing facilities are not being used to anywhere near full capacity, because of the problem of importing raw materials. And the Government is reluctant to issue any license for import of new machinery or the establishment of new plastics industries because such expansion would create a need for more imports of raw materials. Since my visit to Pakistan, the rupee has been devaluated, and I feel convinced that this is only one of the steps toward better business.

As with most countries, Pakistan has one big surplus product. In this case it is jute. Research is now being conducted into the use of jute reinforcement for polyester and other resins. Some thought is being given, too, to the use of chopped reed as fillers for plastics. Necessity may well mother new industries based on this premise.

Egypt

In Egypt the plastics business is concentrated in Cairo and Alexandria. There are a few fairly large plastics plants, but most of the plastics processing is done in the Egyptian equivalent of the European "cottage shops." In huts built in alleys, a whole family will operate one or two small presses, making junk gadgets, trinkets, combs, soap boxes, toys, and costume jewelry. And the family will then sell the product on the streets or in the bazaars.

Large plastics companies in Egypt were subject to shifts in ownership due to recent political changes, and it will be some time before the present regime can stabilize the economic picture.

The most important assist that can be given to plastics in this area will be an improvement in the living standards of the Egyptian people and improvements in home construction, in plumbing facilities, and in health maintenance.

Eastern Characteristics

A few general comments may be in order concerning some aspects of plastics production and merchandising in the Near East and Far East tropical countries.

First, religion is highly important in the lives of these people, and in none of their countries is there any religious objection to plastics. Indeed, a beggar in rags will be wearing a styrene spangle, and the rags, the spangle, and a tin cup will be his sole worldly possessions.

Second, there is the problem of religious holidays and the difficulty of getting scheduled factory production. In a city in which two or three religions are present, there will be several weeks in the year when only one or two days work can be done.

Third is the point of nomenclature. To millions of people in this part of the world, illiterate in even their own language, "Dow" is plastic—any and all plastics—because it is a short word, easily said and easily remembered.

Fourth, aside from their resistance to corrosion, there is another important plus for plastics in the East—and that is their light weight. Nearly everything that is carried in these parts of the world is carried on the backs or on the heads of humans. Lightweight plastics tote boxes and containers thus have an important future.

Fifth, most of the people making plastics in the tropical Easts, whether in a shack or in a sizeable factory, have an attitude toward machinery that must be understood and must be changed. They will work a press until it disintegrates, if it takes 40 years. This, coupled with continued low labor costs and huge populations, is a problem for the governments and industries in those lands. In general the situation is slowly being improved by research and by instruction.—END

Market view of vinyl

(*From pp.* 113-116)

household uses include headrests for bathtubs, window cleaners, paint rollers, doorknob covers, exercise mats, and pincushions.

Since abrasion resistance is good, the foam can be used not only in bath sponges, but also for general household scrubbing. One interesting item was made by electronically heat-sealing a vinyl foam strap to a pad of foam and thus creating a bath sponge (photo, p. 114).

Among the newer applications for the product in flat sheets are church seating, decorative upholstery where a deep dimensional effect is desired, and apparel inserts (photo, p. 116).

Packaging applications are numerous. Foamed vinyl can prove to be particularly advantageous in the production of containers for portage and shipment of delicate machinery, fragile structures, and jewelry articles which require shockproof packaging. Foamed vinyl with interconnecting cells is not recommended for flotation purposes. Water would quickly penetrate the foam and it would lose its buoyancy. Similarly, it would not be suitable for objects such as ice buckets where the interconnecting cells would allow the penetration of water.

Use of the flexible, as well as the rigid, type of foam for acoustical and thermal insulation is now being explored and tested.

Die-cut foam is used for industrial filters, industrial feed and drying rolls, gaskets, sponges, powder puffs, and toys.

Electronic heat-sealing

The ease with which foamed vinyl may be heat sealed is one of the most important features of the product from an application standpoint, and further emphasizes its versatility. Through heat-sealing techniques, low cost production of laminated or sandwich structures consisting of foams sealed to vinyl films, fabrics, or a combination of film and fabric is possible. Embossed and quilted effects achieved by electronic heat-sealing also enhance the appearance of sandwich structures.

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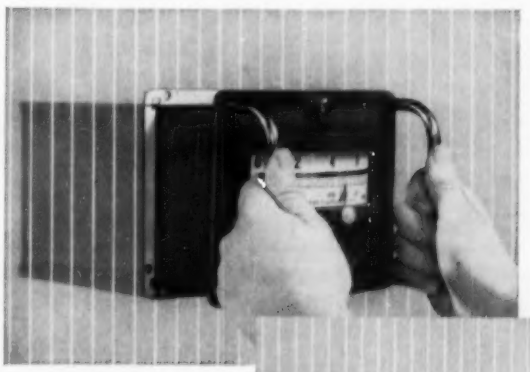

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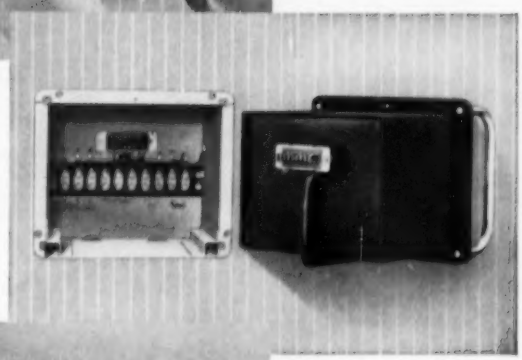

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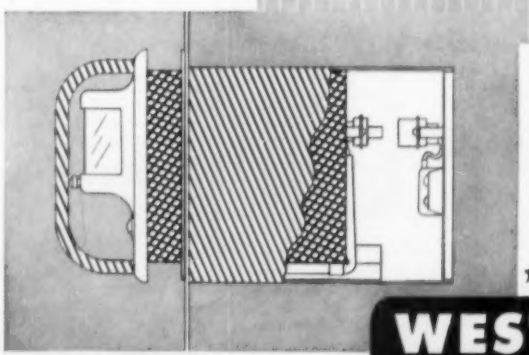

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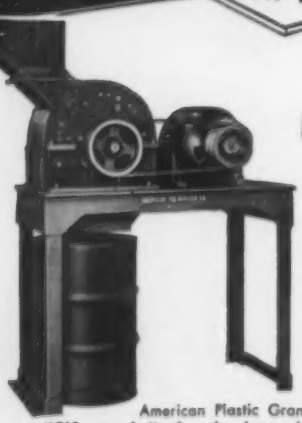

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ing foamed vinyl, a tear-seal die not only shapes the article and performs the sealing operation, but also cuts through the material so that no further cut-trim finish operations are necessary to complete the new product. The finished articles are separated from the sheets in a simple tearing operation as easy as tearing along a perforated line.

Versatility is also inherent in the many different thicknesses and widths in which the vinyl foam can be produced. Sheet stock is currently being made in 54-in. widths, 3 in. thick. Conveyors are being installed to produce sheets 72 in. in width and up to 5 in. thick. Sheet or slab stock can be split without loss into sheets as thin as 1/16 in. on conventional foam or sponge rubber splitting equipment. Already it is practical to produce in quantity densities of between 3½ and 30 lb./cu. ft. with excellent uniformity of cell structure from one extreme to the other.

Solid slabs of foam can easily be cut into special shapes with or without tapered edges.

Molding vinyl foam

Molded vinyl foam applications are generally cored cushions and inserts, such as are used in furniture, bedding, or transportation seating, and articles with integrated or molded skins, including automotive arm rests, crash pads, bicycle seats, and other specialty items.

Molded cushions of any desired contour and with or without coring can be readily made using hot-air fusing ovens.

Such molded cushions can be made with actual densities of 6 lb./cu. foot. This density may further be reduced to an apparent density of 4 lb./cu. ft. by what is for foamed vinyl, as well as for foam rubber, the simple expedient of coring the mold—thereby reducing weight and raw material costs substantially. Cored articles can be readily made in thicknesses up to 6 inches.

Molded cushions are produced by spraying foam into an open aluminum mold connected to a scale. The charge is complete when the predetermined weight of the cushion is indicated. Then

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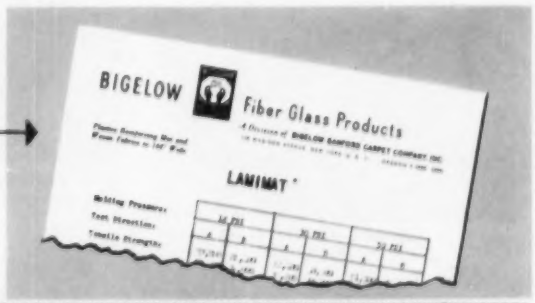

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the mold is closed and the foam is fused in a gas-fired oven at about 350° F. When the cushions are removed from the oven, they are cooled in the mold in a forced draft.

Using this technique, any practical specifications for desired load-carrying or compression-deflection characteristics can be faithfully carried out. The specifications met on the subway cushions for the New York City Transit Authority, for example, called for the cushions to bear a load of 30-35 lb./50 sq. in. without compressing to more than 75% of their original height.

The newest automotive application for molded vinyl foam is in the 1956 padded sun visors (photo, p. 116). Of particular interest in this application was the substitution of a heat-sealed vinyl film over the foam to replace the troublesome slush molded skin previously used for arm rests and other products. Since this product has a large surface area in relation to its size and cost, the risk of a slight surface imperfection occurring was too great. The problem was solved by molding the foam either in two halves or in one piece around the visor insert and then heat-sealing vinyl film with a tear-seal die around the molded foam assembly in order to complete the product. The heat-sealing step can be varied by vacuum forming the film before it is heat-sealed. The formulation problem on this particular application was to obtain high compression while still keeping down the over-all weight of the visor.

Overcoming limitations

While temperature sensitivity cannot be ignored in evaluating the material for specific applications, it should be taken into consideration that many other materials, including vinyl film and coated fabrics, have similar sensitivity and this characteristic has not disqualified them.

Materials with reduced thermal sensitivity are in the laboratory stage. It has been possible to produce a foam which remained flexible at very low temperatures. The major problem in this area, however, has been to make a

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foam, the flexibility of which does not vary with temperature. Extreme compromises in other qualities were necessary in order to achieve this, but this is no longer true to the same degree.

Whatever hardening takes place at extremely low temperatures is purely temporary and does not affect the quality or life of the material. The foam recovers its normal texture and properties on return to normal temperatures.

The matter of migration deserves special attention. When foamed vinyl is brought into direct and prolonged contact with other materials, caution must be exercised in the formulation of the foam so as to prevent marring of certain types of lacquered surfaces.

Standards are needed in order to specify with authority the density and thickness necessary for specific applications. The plastics industry is aware that absence of standards and misapplications of vinyl film during the earlier periods of its development proved a detriment which only the inherent good qualities of vinyl itself eventually overcame.

In most forms, the cost of vinyl foam is competitive with, or lower than, the cost of other flexible foam materials. With constant improvement in production techniques, as well as favorable trends in the cost of raw materials, this material ultimately will undersell other foam materials. The cost situation invariably changes as technological progress is made.

It is reasonable to believe that the price pattern is to be consistently downward. This belief is justified by the fact that mounting production of vinyl resins and of plasticizers will permit price reductions without sacrifice of profits to the foam producers. Furthermore, intensified competition with other materials and the natural eagerness to pre-empt an attractive market would be a constant temptation to offer cost advantages. At the same time installation of improved production equipment and progressive amortization of this equipment can only lead the same way.

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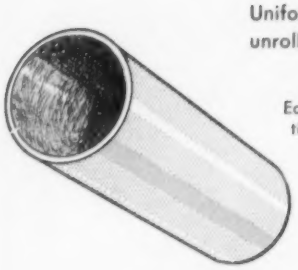

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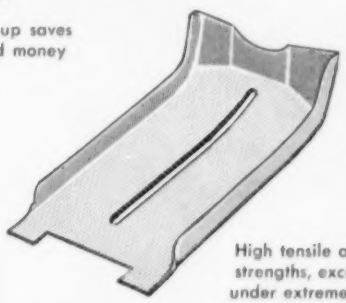

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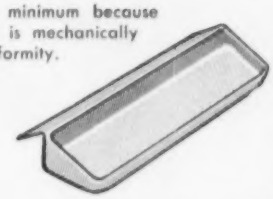

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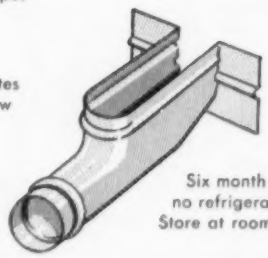

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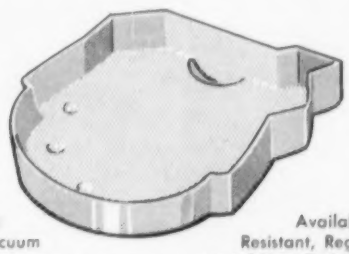

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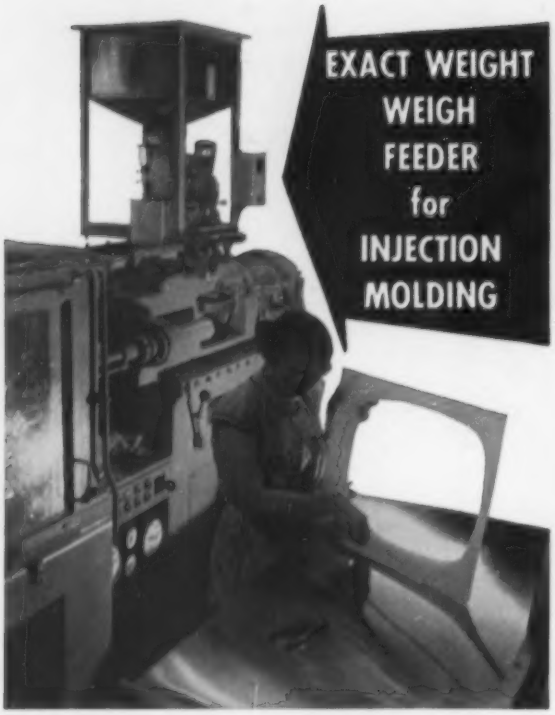

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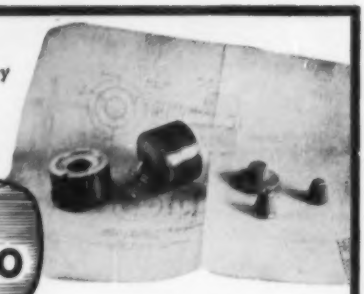

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Plastics housewares

(*From page* 112)

winner was a handsome two-color polyethylene E-Z grip decanter molded by C. B. Cotton & Co., Inc., Brooklyn, N. Y. (photo, p. 112. Honorable mention was awarded to a two-tone kitchen-size salt and pepper shaker set molded by Plastray Corp., Detroit, Mich.

In Class III, which embraced decorative products in either styrene or polyethylene, a self-watering, two-part planter of regular styrene by Bu-Gay Plastic Products, Inc., Chicago, Ill., took first prize (photo, p. 112). Honorable mention went to a two-color, one-quart watering pot molded of regular styrene by Quality Molding Co., Chicago, Ill.

In the classification designated "home maintenance products, either styrene or polyethylene," Columbus Plastic Products, Inc., Columbus, Ohio, was presented with a first prize for its Lustro-Ware step-on can (photo, p. 112). The outside of the can is molded of high-impact styrene in two colors; the inner can, or liner, is molded of white polyethylene.

In this same classification, a pouring pail with lid, both of which are molded of polyethylene, won honorable mention for The Plas-Tex Corp., Los Angeles, Calif.

Judges for the competition were Tucker Madawick of Raymond Loewy Assoc., industrial design consultants; Dr. Jesse H. Day, editor, *S.P.E. Journal;* and Dr. Hugh G. Wales, professor of marketing, University of Illinois.

In keeping with the general theme of the competition—that of encouraging more top-grade plastics products—the top prizes in each of the four classifications were one-year, full-tuition scholarships for product design students to be issued in the names of the winning molders to the college or university of their choice. Both Federal Tool and Bu-Gay chose the Ill. Institute of Technology; Cotton Co. named the Art Institute of Chicago; and Columbus chose the Univ. of Cincinnati. The "best of competition" award consisted of a two-year, full-tuition grant.—END

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Choosing adhesives

(*From pp.* 121-130)

cement to get good adhesion of the evaporated coated surfaces, and they may reduce the unit strength of the finished bond.

(2) Polymer latices. These are suspensions of polymers or elastomers in water. They are often the cheapest and most convenient to use, but the bond is not as strong as that yielded by other methods. As with cements, if both adherends are impervious to water, the water must be completely evaporated before the surfaces are pressed together.

(3) Polymerizable monomers, such as methyl methacrylate. These are slower-setting than the other materials, but have the advantage that no volatiles need be removed.

(4) Curable-resin intermediate, such as urea-formaldehyde, phenol-formaldehyde, melamine-formaldehyde, epoxy, isocyanate, unsaturated polyester. This is the fastest growing group, especially the epoxies, because of their adaptability to a wide variety of situations.

There will always be strain when an adhesive-bonded sandwich is flexed or subjected to temperature change. If the adhesive is stiffer than the adherends, stresses will accumulate at the interfaces upon flexing, and failure may result. If the coefficient of thermal expansion of the adhesive is markedly different from that of the adherends, heating and cooling will cause a stress which increases with film thickness as well as modulus. For both these reasons, the adhesive layer should be thin and somewhat less rigid than the adherends.

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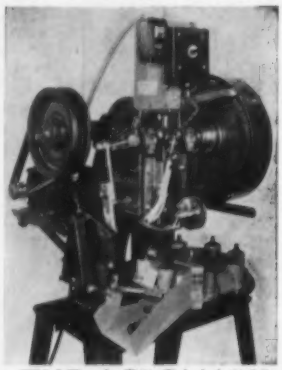

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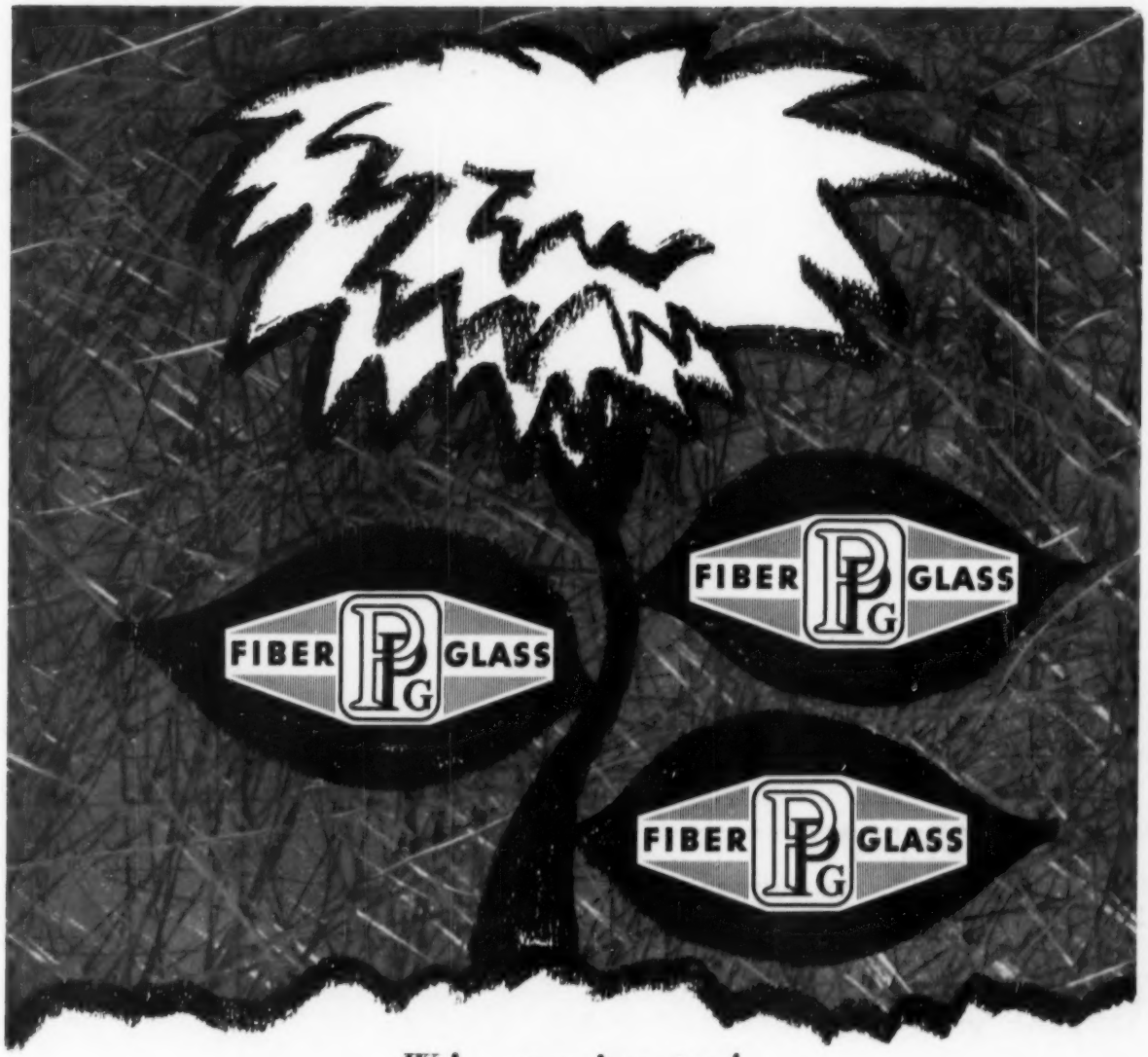

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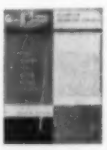

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Balsa cores

(*From pp.* 131-144)

complete without mentioning other techniques used to create desired shapes.

It is possible to bend balsa by sawing closely adjacent grooves across the grain of the convex side of the bend. This eliminates the usual crushing or buckling, but, on the other hand, tends to weaken the wood.

Like other woods, balsa may be sawed, planed, carved, drilled, mitered, sanded, and centerless-ground. In addition, its softness allows it to be die-cut. Flat-grain is commercially die-cut in thicknesses up to ½ in., while end-grain has been die-cut in a 1-in. thickness without encountering any difficulty.

Attempts have been made to crush balsa to shape but they are nearly always unsuccessful for three reasons: 1) there are large point-to-point variations in crushing strength; 2) the forces required are often far above the molding pressures for reinforced plastics; 3) there is a large elastic recovery.

With a number of commercial core forming methods available to the processor of thick reinforced plastic sections, it is hoped that the foregoing will serve as a guide to choosing the technique which will offer the greatest advantage for a particular balsa-core application.

Thermal properties and bonding

Because of its low density and cellular structure, balsa has very low thermal conductivity. As a core material, therefore, it provides an excellent barrier against the passage of heat. On the other hand, since its density is very low, there is very little matter to be heated in a given volume of balsa, so a little heat will get it hot. In heating (or cooling) a block of material, the important property is the thermal diffusivity, a combination of conductivity and other properties. Interestingly enough, as the densities of woods decrease, their diffusivities increase while their conductivities decrease. Thus a less dense balsa both insulates better and heats faster! Typical

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values of these two properties and their relationship with density are shown in the graph of Fig. 20, p. 144.

For use in reinforced plastic structures there are almost no problems in bonding balsa to the sandwich sheets. All the usual resins used in this work adhere well to balsa. The porosity guarantees rapid absorption of water or solvents from the resin mixture and, therefore, hastens the cure.

High-temperature behavior

At temperatures below 350° F. balsa retains its physical properties for long periods, but at higher temperatures its properties are increasingly impaired. Fig. 21, p. 144, shows the loss in weight of balsa versus time of exposure to air at 392° F. Over this 54-hr. interval the shock resistance of the samples dropped to only 3% of their initial value, but after 4.5 hr. they still had about 70% of their original shock resistance.

These figures apply to raw balsa. A balsa core, on the other hand, is not exposed. Complete oxidation of balsa requires 400 times the volume of air contained in the wood itself—and it is mostly air. The reinforced plastics coating protects the wood greatly by keeping air from its surface. An example of what such a core can stand in the way of high temperatures is presented in a guided missile containing a balsa-cored fin. The missile was shroud-fired at seven times the speed of sound! Even under the tremendous heat that is generated at such high speeds, the core managed to survive in good condition.

Electrical properties

Figure 22, p. 144, shows the variation of dielectric strength and dissipation factor or loss factor with frequency at 79° F. The samples on which these data were taken were oven-dried and their density was not measured. As-received values (moisture content unknown but probably under 15%) were at 10^3 c.p.s., dielectric constant was 1.45, loss was 0.031; at 10^4 c.p.s. they were 1.36 and 0.0137. It is apparent

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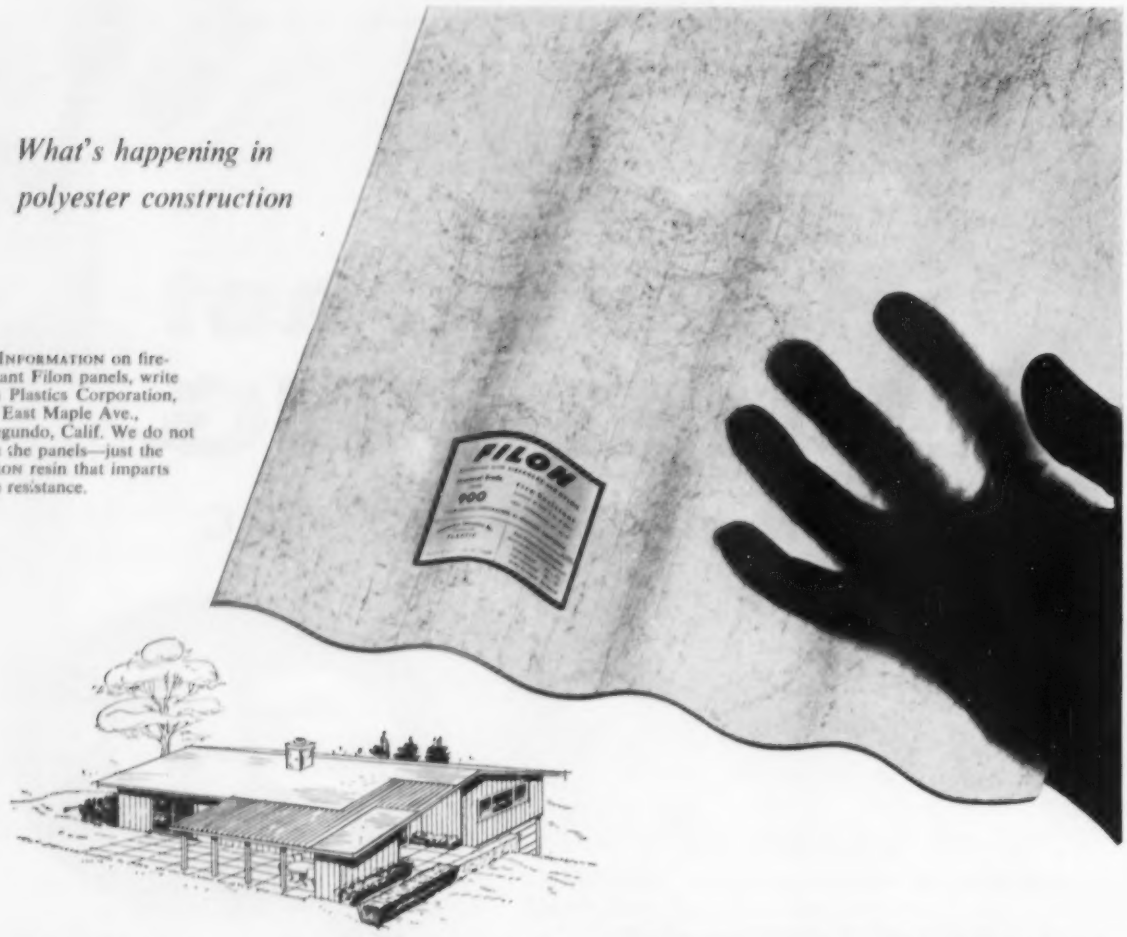

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that while moisture greatly increases the loss factor, it has very little influence, in this range, on the dielectric constant.

Moisture and fungi

As a core material in reinforced plastics, balsa is always completely sealed in. Any variation in moisture content of the core material after lamination will depend primarily on skin integrity. It has been shown that kiln-dried balsa cores pick up moisture only if the surface laminate is porous and continuously immersed.

In 14 years of use in reinforced plastics, there has not been a single reported case of fungus attack. Research findings reveal the reasons for this immunity from attack. Rot and decay can occur only under certain conditions and these conditions do not occur in a reinforced plastics sandwich structure. There is sterilization of the balsa core at the time of kiln drying and the core is resterilized during curing by the heat of reaction. Exposure to 170° F. is sufficient to kill fungal spores and tissue. This sterilization is an important reason for kiln drying the wood. Any subsequent attack must come via penetration of the skin material. Studies to date indicate that even porous reinforced laminates do not present passages large enough for fungal spores.

Conclusion

Balsa wood is an economical and versatile core material for reinforced plastics structures. As a core material it has good strength, fatigue resistance, and can perform well in extremes of moisture and heat. Many techniques are available for forming it.

Acknowledgments

Special appreciation is extended to Messrs. David G. Reid of Republic Aviation Corp. and Alan W. Sliker of the State University of New York, for material supplied in connection with this paper. The firms and public agencies which were kind enough to furnish the data and the illustrations which are shown here are also due the author's sincere gratitude.—END

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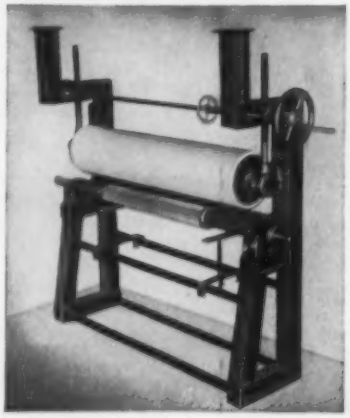

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(*From pp. 157-162*)

observations and assisting in their analysis involves using a wide range of applied stresses. A graphical plot of the observed crazing or rupture time on a log scale *versus* the applied stress on a linear scale yields approximately straight lines.

The product of beam deflection times specimen thickness is proportional to the maximum strain in the specimen. Plots of this product *versus* time usually show inflections (Fig. 6, p. 160) which can be directly coordinated to major weather changes (temperature and average humidity). Such data also confirm critical creep strain theory as applied to linear polymers (11, 12, 16). This is shown by the data in Table III, p. 162.

Beam deflection times specimen thickness data are in general more reproducible than the accompanying crazing observations. It is interesting to note that in one test extending over a period of 900 days (2.45 yr.) Plexiglas 1-A specimens attained approximately the same maximum strain value before crazing (at different times) under applied stresses of 2000, 3000, and 4000 p.s.i.

The significance of the effect of outdoor weathering on the crazing resistance of basically different plastics is illustrated by the data in Table IV, p. 162. These data show the polyester-type material to be essentially equal to the heat-resistant acrylic, somewhat inferior to the heat- and craze-resistant acrylic, and definitely inferior to the modified acrylic in crazing resistance. In laboratory atmosphere tests the polyester resin could not be crazed by stresses of 6000 p.s.i. or less. Time to rupture data are shown in Fig. 7, p. 162.

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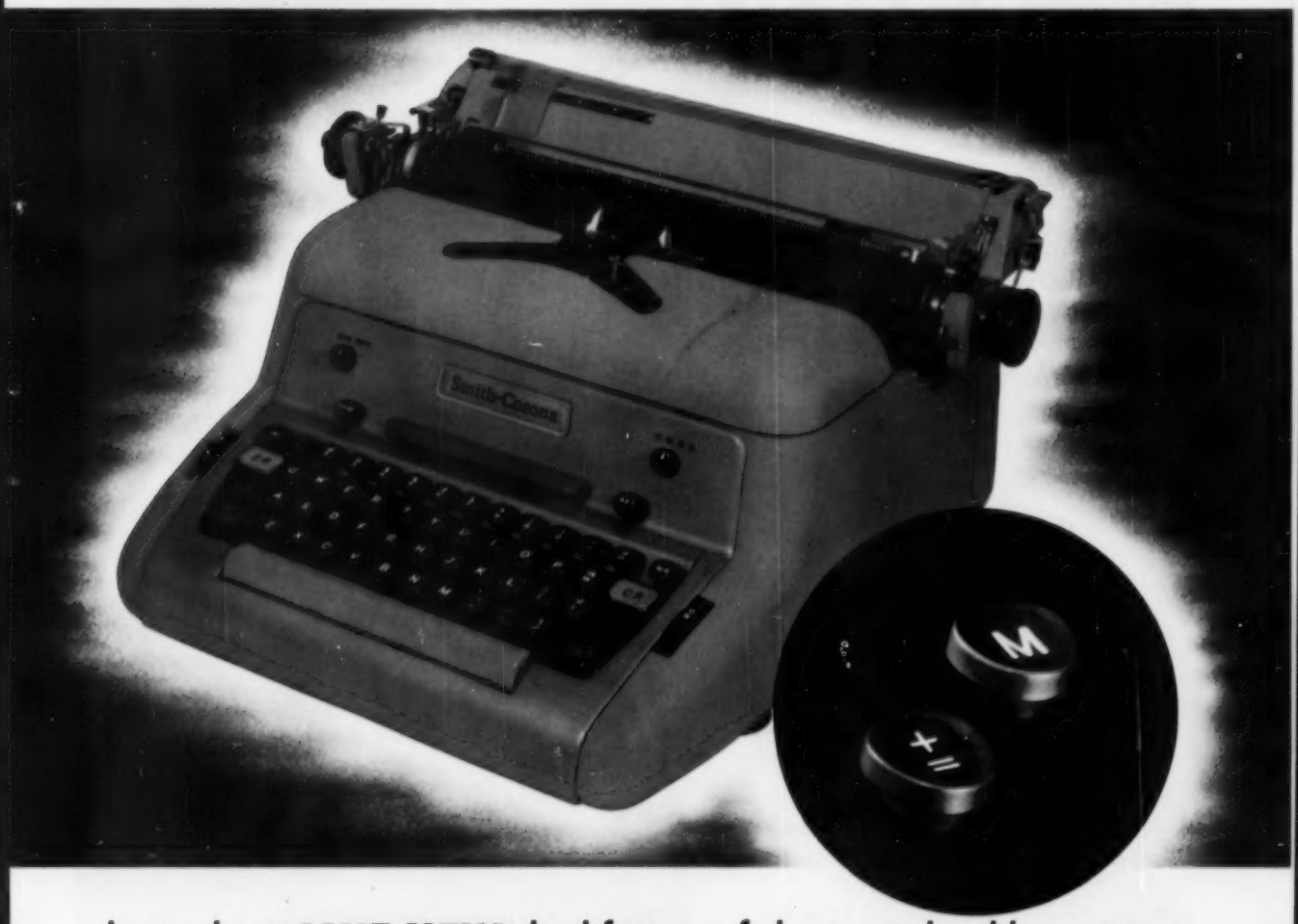

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MULTI-PURPOSE ADHESIVE. Literature describes and gives step-by-step instructions for using "Resiweld" transparent adhesive, designed to bond strongly an extensive variety of metals and plastics to themselves and to each other. H. B. Fuller Company. **(E-604)**

Any of the booklets described here, plus many others—forty-four in all—are available for the asking, without charge or obligation.

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The Plastiscope

News and interpretations of the news
By R. L. Van Boskirk

Section 2 (*Section 1 starts on p. 33*)

Polyethylene for building

Polyethylene film for use by the building and construction industry is now offered in 2, 4, and 6 gages and in widths up to 16½ ft. by Olin Mathieson Chemical Corp., 460 Park Ave., New York, N. Y.

Herbert Childs, polyethylene product manager for Olin, states that the material aids in solving long-time problems of the building trade. The use of polyethylene as a moisture barrier for walls and floors means longer life for exterior paint jobs. It also inhibits paint peeling on the inside and keeps wallpaper from being stained because of moisture seepage through the walls. In addition to acting as a moisture and vapor barrier, the film has proved useful to builders as a means of closing in a building to protect workers from cold, rain, and snow and permit the job to continue under adverse weather conditions; as an effective cover to protect lumber, equipment, or other building materials from the weather; and as an aid in curing concrete and masonry to achieve maximum cured strength in a minimum amount of time and at less cost.

Some of the advantages of the film as outlined by the company are: Cost for polyethylene in an average $20,000 home is about $65. This compares with approximately $80 for an equivalent material in the same home. There is also a saving when the film is used to protect building material. In a home of the same size, about $20 to $30 worth of polyethylene will keep all of the materials covered. This polyethylene can be re-used many times.

Mr. Childs asserts that the best places to use polyethylene in a building are: under the basement floors and around foundation walls; over the earth in crawl-space-type houses; under slab construction where it acts as a moisture vapor barrier; between the floor and sub-flooring as an air and dust barrier; and on the warm side of wall studding as a moisture and vapor barrier.

* Reg. U. S. Pat. Off.

Plastics in car interior

An experimental automobile interior, utilizing plastics in several novel applications including reinforced polyester seats upholstered with urethane foam, has been designed and built by four students at Pratt Institute, Brooklyn, N. Y., as part of a program sponsored by Monsanto Chemical Co. According to Joshua S. Miller, manager of automotive sales of Monsanto's Plastics Div., the main objective of the program was to endow young designers with a broad working knowledge of plastics and their capabilities.

Mr. Miller states that probably the most significant use of plastics in the model is in its seating. The bucket—bottom and back—of the seat is molded in one piece of reinforced polyester, eliminating a need for complicated assembly techniques. Upholstered with urethane foam and coated with sprayed-on vinyl, it is at the same time sufficiently durable and decorative to reduce the present high production costs.

The door liner, another one-piece unit which slides into place and fastens quickly and easily, is made of high-impact styrene and can have a variety of colors and finishes, with either a sprayed or laminated vinyl surface. The molded-in arm rests are cushioned with resilient urethane foam. As a head liner to cover the inside of the car roof, the students used styrene molded in one piece and snapped into place.

Polyester, vinyl, or styrene, padded with urethane foam for safety, are suggested for the one-piece instrument panel, which would replace the multi-section panels in today's automobiles.

Other features in the model include a flexible roll-out plastic map; a one-piece styrene deck shelf behind the seat; and a vinyl floor covering which can be sprayed on or laminated to the steel body of the car.

Metallized plastics

Metallized plastics, including Mylar and cellulose acetate, are now available from Foiltone Products, Inc., a wholly-owned subsidiary of National Research Corp., 70 Memorial Dr., Cambridge, Mass. The company also states that it will soon manufacture metallized polyethylene and vinyl films.

National Research has been actively engaged in the development of continuous metallizing processes and equipment for about 15 years. Two licensees are presently producing and selling metallized fabric and plastics products. Foiltone Products was formed to commercialize certain research achievements of NRC in continuous vacuum metallizing.

Plastic "paper"

Manufacture of synthetic fiber "paper" has now reached the pilot-plant stage, according to a report by John R. Emery, of Du Pont, given at the annual meeting of the Technical Association of the Pulp and Paper Industry. The "papers" actually bear little resemblance to paper in the usual sense of the word, the term being used because the materials are produced on papermaking machinery. "Non-woven bonded structures" would be a more correct designation.

Du Pont has been producing these papers from nylon, Dacron polyester fiber, Orlon acrylic fiber, and from blends of those fibers with wood pulp; the company's pilot-plant experience indicates that synthetic fiber paper

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is commercially practical. Considerable product development work and marketing research are currently being done by Du Pont and paper manufacturers.

Uses for which these papers are suggested include: high-pressure laminate reinforcement, coated fabrics, felt-like structures for low-pressure laminate reinforcing batts, and many others.

The papers can be made in a wide range of appearances and characteristics, from crisp paper-like structures to drapable fabric-like, tough parchment-like, or bulky felt-like structures.

Plastics in building

A two-week special summer session on plastics in building is offered at the Massachusetts Institute of Technology, Cambridge, Mass., from July 2 through July 13.

The program will stress the use of reinforced plastics and will cover both design and construction.

Metals and chemicals

New developments in metals and their chemicals is the subject of the next meeting of the Commercial Chemical Development Association, to be held on May 3 and 4 at Pocono Manor Inn, Mt. Pocono, Pa.

Metals and their related chemicals to be discussed are tin, lithium, thorium, titanium, uranium, tantalum, and columbium, several of which have at least an indirect interest to plastics chemists.

Fatty alcohols

Tank car quantities of Unadol 40 and Unadol 90, unsaturated, noncorrosive alcohols, are now available from Archer-Daniels-Midland Co.'s Chemical Products Div., 2191 W. 110th St., Cleveland, Ohio. Unadols 40 and 90 are among the many new saturated and unsaturated fatty alcohols which are being made commercially available for the first time from the company's new Ashtabula, Ohio, plant.

The alcohols are suggested for use in the production of new protective coatings, resins, surface active agents, and chemicals.

Vinyl standards

Copies of the Commercial Standard for Rigid Polyvinyl Chloride Sheets, CS201-55, are now available from the Superintendent of Documents, Government Printing Office, Washington 25, D. C., for 10¢ each.

The Commercial Standard covers physical and chemical properties and methods of test for high- and normal-impact, chemical-resistant rigid polyvinyl chloride sheets. The Standard recommends a uniform method of declaring compliance.

Lubricants for vinyls

Six non-volatile lubricants are now being marketed by The Baker Castor Oil Co., 120 Broadway, New York 5, N. Y. The firm states that the lubricants are not only suitable for rigid vinyl processing, but can also be used to advantage in flexible vinyl compounds where plasticizer composition cannot be changed but where greater processing lubricity is required.

Design competitions

Two concurrent design contests for applications of thermoplastic rods and tubes have been announced by Cadillac Plastic & Chemical Co.

First prize in the open contest is $1000. Second prizes of $150 are offered in each of the following three categories: consumer product; industrial or technical product; architectural or decorative.

The parallel contest for students offers top prize of $250 and three second prizes (applying to the same categories) of $75 each.

The company states that the purpose of the contests is to reward and encourage the design profession's awareness of the versatility, flexibility, and variety of thermoplastic rods and tubes.

Entries in the open contest are restricted to product designs now in production or in tooling by December 1, 1956. No speculative sketches or display prototypes will be judged.

In the student contest, speculative displays and prototypes as well as actual product designs will be judged. All designs will remain the property of the contestants.

Any usage of cast or extruded rods of any thermoplastic material in any phase of consumer or industrial products is eligible for the contests.

The contests will be judged by aptness and interest of the application; problem-solving ingenuity; and understanding of the functional possibilities of the thermoplastic material.

The contest judges are: John Arnold, associate professor of mechanical engineering, Massachusetts Institute of Technology; George Beck, industrial design manager, Television Receiver Div., General Electric Co.; William T. Cruse, executive vice president, Society of the Plastics Industry, Inc.; Hiram McCann, editor, MODERN PLASTICS magazine; Jane Fiske Mitarachi, editor, *Industrial Design* magazine; and Jean Reinecke, Reinecke & Associates, design consultants.

Deadline for entries is September 30, 1956. Additional information may be obtained from Ladd Orr, IDI, contest advisor, Cadillac Plastic & Chemical Co., 15111 Second St., Detroit 3, Mich. Information is also available from the company's branches in Chicago, Ill.; St. Louis, Mo.; and Los Angeles and San Francisco, Calif.

Preformed Teflon

Factory-preformed Teflon aircraft hose assemblies, which save weight and space, and also eliminate the need for special elbows, are now available from Resistoflex Corp., Roseland, N. J.

Designated Preformed Fluoroflex-T R3800 hose assemblies, the lines are permanently formed to get around obstructions yet make connections in the shortest possible length. The company

states that preforming permits substantially smaller bend radii with minimum restriction of inside diameter when compared to unpreformed assemblies using elbows. By permanently preforming the hose during manufacture, stress and strain are eliminated in the critical bends and neat, efficient plumbing design is made easy.

Polyethylene group elects

At the annual meeting of the Polyethylene Extrusion Coaters Group, Donald McBride, Lowe Paper Co., Ridgefield, N. J., was elected chairman and C. Carr Sherman, The H. P. Smith Paper Co., Chicago, Ill., vice chairman.

The group is a division of the Specialty Paper and Board Affiliates.

Industrial design award

The sixth annual design award program is being launched by the Industrial Designers' Institute. It is aimed at giving professional recognition to industrial designers for noteworthy and fresh approaches to design and function, combined with practical uses of appropriate materials.

The competition is open to all designers or designer teams. Designs accepted for consideration must be mass produced and nationally distributed and in production in 1955-1956.

Full details of the IDI award program are contained in the application forms, which may be obtained from Walter C. Granville, Container Corp. of America, 38 S. Dearborn St., Chicago, Ill. The submitted forms must be postmarked May 19.

Laboratory financing

A plan to enable small and medium-sized companies to establish or expand laboratory facilities, and thus meet competition, has been formulated by Chicago Apparatus Co., 1735 N. Ashland Ave., Chicago 22, Ill. This plan is of particular interest to small companies in the plastics industry which need laboratories to develop new products and run tests on durability, color possibility and color fastness, tensile strength, stress, and brittleness.

Upon application, interested firms will be contacted by Chicago Apparatus technical representatives who will help plan laboratory establishment, expansion, and financing arrangements.

Summer courses

The thirteenth annual summer laboratory program for industry conducted by Polytechnic Institute of Brooklyn will commence on May 28. Among the courses offered are: Progress in Polymerization and Copolymerization Techniques; Properties of Macromolecules in Solution; and Ion Exchange.

In addition to these classes, a series of general evening lectures in polymer chemistry is being offered. These lectures are designed to meet the interest of scientists in the New York metropolitan area who do not wish to enroll for the laboratory portion of the courses. Co-directors of the program are Dr. Herman F. Mark and Dr. Isidor Fankuchen.

Inquiries and registration applications should be addressed to Mrs. Doris Cattell, secretary, Summer Laboratory Courses, Polytechnic Institute of Brooklyn, 99 Livingston St., Brooklyn 1, N. Y.

Named to A.S.T.M. committee

At a meeting of the American Society for Testing Materials, the following officers were elected: Chairman of the committee on plastics—Frank W. Reinhart, chief, Plastics Section, National Bureau of Standards; first vice chairman—A. C. Webber, E. I. du Pont de Nemours & Co., Inc.; second vice chairman—Professor A. G. H. Dietz, Massachusetts Institute of Technology; secretary—J. B. DeCoste, Bell Telephone Laboratories; and membership secretary—R. H. Carey, Bakelite Co.

Packaging symposium

The second joint military-industry symposium on packaging and materials handling will be sponsored by the United States Air Force, in cooperation with all military services, the Department of Commerce, and the National Security Industrial Association. The symposium will be held in the Departmental and Department of Commerce auditoriums, Washington 25, D. C., from October 9 through October 11.

The program is currently under development. Firms and individuals desiring to make suggestions should contact the Packaging and Materials Handling Div., Director of Transportation, DCS/M, USAF Headquarters, Washington 25, D. C.

TAPPI coating conference

A feature of the seventh TAPPI coating conference, to be held from May 7 to 10 at the Benjamin Franklin Hotel, Philadelphia, Pa., will be a paper by Dr. H. F. Mark, director, Polymer Research Institute, Polytechnic Institute of Brooklyn, entitled "Principles of Adhesion."

The over-all subject for the meeting is synthetic adhesives for paper coating.

Merchandising award

Presentation of a plaque for outstanding housewares merchandising performance was made to William Hardman, Jr., president of Royal Plastics Co., party plan distributor of Providence, R. I., by Joseph M. Jayne, vice president and general manager of The Plas-Tex Corp., Los Angeles, Calif.

Royal Plastics now has party dealers in 28 states, does business as far west as California, and maintains branch operations in Manchester, N. H., Boston and Taunton, Mass., as well as the Providence home office.

Plas-Tex, which made the award, manufactures plastics housewares.

Fire-resistant polyester

Brightly colored, fire-retardant panels for roofing, skylighting, and side lighting are now being produced by Filon Plastics Corp., El Segundo, Calif. The translucent panels, which carry the Underwriters' Laboratories label, are made from fibrous glass and Hetron, a fire-resistant polyester resin manufactured by Hooker Electrochemical Co., Niagara Falls, N. Y.

U/L-listed and labeled translucent panels incorporating Hetron may now be obtained with flame spread values of from 40 to 75 by

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the Tunnel Test specified by the American Society of Testing Materials. This compares with ratings of 0 for asbestos, 100 for red oak, and more than 400 for ordinary polyester panels.

Contact adhesive

A new contact-type adhesive, P297, has been announced by Wilross Products Co., Hawthorne, N. J., manufacturer of adhesives for the plastics industry. The product is essentially a co-reacted resin rubber complex dispersed in an aromatic hydrocarbon.

According to the manufacturer, P297 will bond plastics, metals, wood, cloth, paper, rubber, and concrete to themselves and to each other.

A.S.T.M. program

Among the features of the American Society for Testing Materials meeting, to be held from June 17 to 22 at Chalfonte-Haddon Hall, Atlantic City, N. J., will be the Edgar Marburg lecture by Dr. Charles E. Reed, general manager, Silicone Products Dept., General Electric Co., on "The Chemical Properties and Applications of Silicones."

There will be 31 sessions beginning on Monday morning and continuing until Friday noon. The society's twelfth exhibit of testing and scientific apparatus and laboratory supplies will be one of the attractions.

Styrene tile promotion

To encourage the use of plastic wall tile and to establish a two-way flow of information between the plastic wall tile industry and architects, builders, contractors of tiling, and dealers, a promotional program has been instituted by the Plastic Wall Tile Div. of the Society of the Plastics Industry, Inc.

One of the prime objectives will be to help coordinate the activities of all those concerned with the manufacture and sale of plastic wall tile—from raw materials suppliers to ultimate consumers.

Focal point of the program will be the accent on quality plastic wall tile and quality installations. Part of the educational program to the consumer will be directed towards pointing out the significance of the United States Department of Commerce Commercial Standard 168-50 and the Hallmark which indicates compliance with the provisions for minimum standards of quality for polystyrene plastic wall tile and for the adhesives used in their application.

Automation conference

The eleventh annual International Instrument-Automation Conference and Exhibit, under the auspices of the Instrument Society of America, will be held from September 17 through 21 at the New Coliseum, New York, N. Y.

Close to 300 companies will exhibit the latest control devices, a number of which will find application in various phases of the plastics industry.

Color for polyesters

New, improved paste color concentrates for polyester resins have been developed by the Ferro Color Laboratory of Ferro Corp., 4150 E. 56th St., Cleveland 5, Ohio. Durometer tests show that these color concentrates do not affect surface hardness. They have heat and light stability, good dispersion, and are compatible with all types of polyester resins, including gel-coats.

Finish for glass cloth

Development of a new and practical finish for heat-cleaned glass cloth used in structural laminates has been announced by Dow Corning Corp., Midland, Mich. Designated Dow Corning T-31, the finish is said to be effective with epoxy, phenolic, polyester, and silicone resins, enabling laminators to meet a wide range of specifications with a single type of finished glass cloth.

A solution of silicone in methyl cellosolve, one part of T-31 may be diluted in 60 to 80 parts of water for application in conventional finishing equipment. No washing, neutralizing, or curing is required—just dip and dry.

Quick-setting glue

Tradenamed Federal B4A, a new room-temperature curing adhesive has been developed by Federal Adhesive Corp., 210 Wythe Ave., Brooklyn, N. Y. The adhesive, a synthetic resin emulsion, is supplied as a ready-for-use white liquid, easily dilutable with water. Its setting characteristics are said to be very fast, producing a bond which is strong, tough, and water resistant, with a minimum of cold flow or creep.

Recommended uses for Federal B4A are: bonding of woods, paper-boards, and textiles to each other or to porcelain, steel, etc.

Propionic acid

Tank-car quantities of propionic acid, made from Oxo-derived propionaldehyde, is now being supplied by Carbide and Carbon Chemicals Co., a Div. of Union Carbide and Carbon Corp., 30 E. 42nd St., New York, N. Y.

Propionic acid is an intermediate for vinyl propionate monomer, a raw material for water-resistant latex paints, adhesives, and coatings; for cellulose propionate, a high-impact thermoplastic; and for other products.

Plasticizer news

Rubber Corp.'s plasticizers. Two new plasticizers—D-31 and DID-P-10—have been developed by the Latex and Chemical Div. of Rubber Corp. of America, Hicksville, N. Y.

D-31 is reported to be a low-cost replacement for normal octyl decyl phthalate (N.O.D.P.). It is a blend of di-isodecyl phthalate and di-isodecyl adipate which functions as a low-temperature plasticizer for polyvinyl chloride. Unusually good efficiency and performance are claimed. The

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I.C.I. 'Alkathene' insulates the new transatlantic telephone cable.
I.C.I. are proud to have kept the signal flag flying with their contribution to the new Transatlantic telephone cable; when completed at the end of 1956 it will be the first telephone cable system to link the New World and the Old, and will provide for 35 simultaneous conversations. Submarine Cables Ltd., London, are using 'Alkathene' as the insulant in making the greater part of the undersea cable for the new system, comprising two cables between Oban and Newfoundland and a single cable on to Nova Scotia. The first of the cables—already laid at depths up to three miles—is the longest and deepest telephone cable in the world; it will be matched by the second which, together with the cable to Nova Scotia, is to be laid this year.

'Alkathene' is the registered trade mark for the polythene made by
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product is claimed to exhibit lower volatility, reduced water sensitivity, and better heat stability when compared to blends of the more common dioctyl phthalate and adipate.

DIDP-10 has been formulated for wire coating application and for use in films, hose, floor tile, plastisols, outerwear, upholstery, etc. According to the manufacturer, DIDP-10 is designed to improve low-temperature brittle points in polyvinyl chloride compounds while maintaining the low-volatility characteristics of the higher phthalate esters.

Pipe notes

Tags for pipe. A quality-tag program to aid buyers of polyethylene pipe has been announced by Bakelite Co., a Div. of Union Carbide and Carbon Corp. A hang-tag attached to a coil of flexible pipe identifies it as being made of Bakelite polyethylene, developed especially for water system piping. The hang-tag contains the pipe manufacturer's imprint, identification of Bakelite polyethylene as the base material, and useful suggestions on how to install flexible pipe.

Pipe and fittings. Franklin Plastics, Inc., Franklin, Pa., announces the installation of additional equipment for the manufacture of Dur-X pipe and fittings which will increase production capacity of its Products Div. by approximately 50 percent. More equipment is on order.

Expansion

Witco Chemical Co.'s new pilot plant at the Chicago, Ill., laboratories of its Emulsol Div. will give the company complete facilities for technical service on urethane foams. **Dr. Charles F. Fuchs,** Emulsol vice president in charge of research, states that in the past, technical service—and even research—on this new resin had been handicapped by lack of suitable equipment with which to duplicate foams made in large production units.

Max A. Minning, president of Witco, asserts that the company has no intention of starting commercial foam production. "We are interested only in the manufacture of raw materials which will improve the qualities of polyurethane foams," he states. Witco is already producing Witco 77-86, which is used as a coupler in the formation of odor-free polyurethane foams.

General American Transportation Corp.'s new research and developmental laboratory for its Plastics Div. is expected to be in operation by July 1; it will be 8000 sq. ft. in area. Address is 300 E. 51st St., East Chicago, Ind., adjacent to the present plant of the division.

Equipment will include facilities for work in the field of reinforced plastics, compression and injection molding, extrusion, vacuum forming, and related operations. An air-conditioned and humidity-controlled room will house complete testing facilities.

Campro Co. will construct a 25,000-sq. ft. factory and office building on a 15-acre site on Route 62, Canton, Ohio, one mile east of the city. The plant is scheduled for occupancy in November.

The company will continue operations at its present factory at 1300 Fourth St., S. W., Canton. Campro is engaged in custom molding and, in addition, markets its own line of products in the housewares, hardware, and stationery fields.

United States Plywood Corp. has recently acquired **Youngs Bay Lumber Co., Inc.,** Roseburg, Ore., and plans to construct new plywood and Novoply plants in Roseburg. **S. W. Antonville,** president of U. S. Plywood, contemplates that the new plywood plant will have an initial annual capacity of approximately 75 million feet.

Novoply is a wood panel produced from resin-coated wood chips and flakes which are by-products of the company's plywood plant and sawmill operations.

National Aniline Div., Allied Chemical & Dye Corp., plans an addition to its Research-Engineering Center at the Buffalo, N. Y., plant to provide increased space for application research on di-isocyanates. The company's new plant for the production of these materials, sold under the trade designation Nacconates, is now nearing completion in Moundsville, W. Va.

Shell Chemical Co. has constructed a new resin unit at its Houston, Texas, plant to manufacture market development quantities of new epoxy resins. It is anticipated that production from the new unit will encourage industry to find many additional uses for the resins.

Lawrence Process Co., Lawrence, Mass., has opened a new plant in North Andover, Mass., comprising an area of 43,000 sq. ft. on a 10-acre site already graded and prepared for future expansion. The company began its operations less than five years ago in temporary leased space.

Lawrence produces vinyl shoe welting, called Perma Seal, and garden hose. The firm plans to introduce in the near future its Perma-Flex "Do-it-Yourself" underground sprinkler unit.

The Barber-Webb Co., Inc., Los Angeles, Calif., has recently completed a $100,000 expansion program at its Vernon, Calif., plant.

A tank more than 22 ft. long, 6 ft. deep, stepped from 2½ to 6 ft. wide, and holding approximately 4000 gal. of material has been installed for the company's polyvinyl chloride plastisol dipping operation; an overhead materials handling bridge crane system has been added; and a large, new oven, 27 ft. long, 10 ft. wide, and 12 ft. high, has been put into

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• The POLYLITE plastic trailer you see here weighs 2000 pounds less than a comparable van made of aluminum...and 3500 pounds less than one of steel. In terms of payload, *that ain't hay!* It permits vans with up to 15% more cube, too.

For added durability and easy cleaning the interior of the van is also fabricated with tough POLYLITE resin. (Three inches of fibrous glass insulation separate the plastic exterior from the POLYLITE interior.) Attractive, permanent color was incorporated in the reinforced plastic sides and top of the 32-foot van at the time of fabrication.

At RCI we've had three of these trailers built for us by Strick Co., Philadelphia, a pioneer in this application of POLYLITE.

In small parts or something as big as this trailer, POLYLITE construction can offer *you* advantages, too. Do you want lightweight strength? Durability? Easy maintenance? Write to RCI about POLYLITE for your products. And ask for *Booklet A.*

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REICHHOLD CHEMICALS, INC.
RCI BUILDING, WHITE PLAINS, N. Y.

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operation. The company states that it can now apply anti-corrosion coatings to the largest pieces of industrial equipment.

Hidalgo Chemical Co. has completed its rehabilitation program and has started production at its Brownsville, Texas, plant. Products include alcohols, aldehydes, ketones, and acids used in the manufacture of plastics, paints, varnishes, pharmaceuticals, and cosmetics.

Haveg Industries, Inc., has acquired facilities in West Warren, Mass., for the manufacture of polyester-fibrous glass equipment for chemical and corrosion-resistant services. This represents a diversification and expansion for the company. Heretofore, Haveg had been engaged in the fabrication of phenolic and furan resins.

Polyester fabrication operations in West Warren will be conducted by Haveg's Pla-Tank Div.

A newly created marine department at 101 Central Ave., Westfield, N. J., will merchandise Haveg's reinforced polyester marine products, including the company's line of molded fibrous glass outboard boats designated Havegcraft. Havegcrafts will also be molded at the West Warren plant.

Chemical Corp. has been appointed as a distributor for Haveg in the New England and eastern New York state areas.

Malco Plastics, Inc. has doubled its floor space at 4100 Plastics Place, Baltimore, Md. The company also announces that warehouse space for Bakelite rigid vinyl sheets for the trade will be more than doubled in response to increased demand.

Sylvania Electric Products, Inc. announces plans for the construction of a new 110,000-sq. ft. plant in Warren, Pa., for its Parts Div. The structure will provide the necessary space for expanding the company's high-speed automatic thermoset molding activities. The plant, scheduled for completion in December 1956, will house all plastics operations of the division.

Company notes

Union Carbide: Important objectives of **Union Carbide Development Co.,** a new division of Union Carbide and Carbon Corp., will be long-term planning and evaluation of new business opportunities. Operating divisions of UCC will continue to carry on their own research and development activities. **Birny Mason, Jr.,** formerly secretary of UCC, is now president of the new division; **R. E. Cornwell, E. J. Fox,** and **J. J. Murphy** are vice presidents.

Carbide and Carbon Chemicals: E. D. Murphy has been appointed manager, Sales Control; **R. D. Glenn,** assistant works manager; **R. L. Duncan, F. J. Rauscher,** and **E. R. Young,** assistant sales managers. **R. C. Boltz** is new eastern division manager in New York; **J. R. Hulten,** central division manager at Cleveland, Ohio; **H. P. White,** Pacific Coast assistant division manager at San Francisco, Calif. **F. H. Belden** has been named general superintendent of South Charleston, W. Va., plant and **R. C. Hieronymus** a superintendent. **H. A. Stuewe** is new assistant superintendent of Texas City, Texas, plant.

Barrett Div., Allied Chemical & Dye Corp., has established two new district offices to provide customer sales and service for Plaskon polyester resins, laminates, polyurethane foams, premixes, glues and adhesives, foundry resins, paper-treating resins, and phenolic resins.

The eastern district office is in New York City. **W. H. Hough,** formerly sales representative of the Industrial Resins Dept., will head the office. The Detroit, Mich., office will serve the midwestern and southwestern districts. **J. N. Grove,** formerly special representative for Plaskon polyester resins and oils, is now district manager of the office.

Barrett also announces that **J. E. Shand** has been named assistant to **L. W. Miller,** manager, Chemical Sales, and **John C. Esher** assistant sales manager.

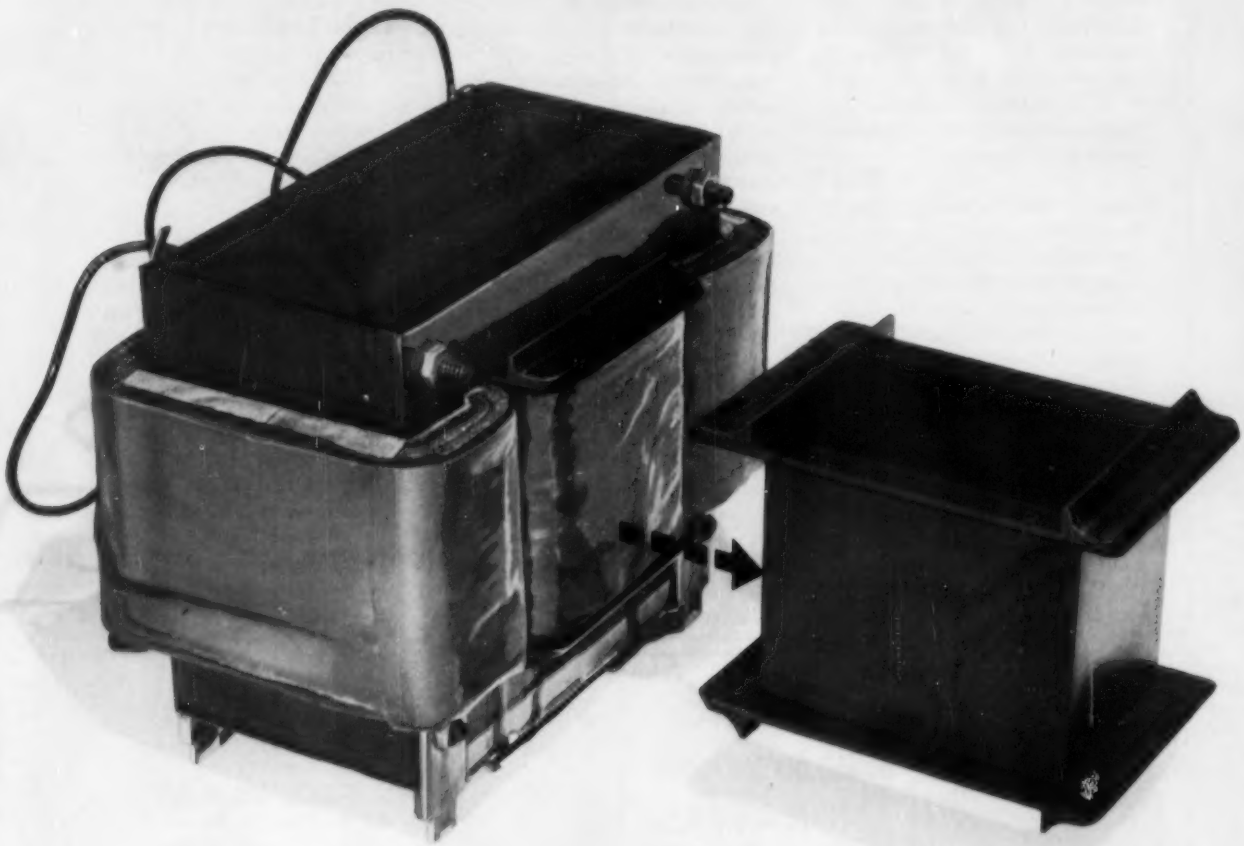
Du Pont: Dr. Arthur H. Hale and **Dr. Marcus A. Naylor** have new posts in the research division of the Polychemicals Dept. at the Experimental Station near Wilmington, Del. Dr. Hale is now assistant to the general laboratory director and will be responsible for activities pertaining to technical personnel. Dr. Naylor, formerly with the department's planning division, is now section manager in the research division. He will direct the studies of a group of chemists on Zytel nylon resin.

National Starch Products: S. F. Thune, formerly a vice president and manager of the Midwest Div., has been promoted to sales vice president of **National Adhesives Div.,** New York. **Frank Murphy** succeeds Mr. Thune as manager of the Midwest Div., Chicago, Ill. **R. A. De Wolfe,** formerly New York adhesive sales supervisor, is now manager of the Pacific Coast Div. **Larry Horan,** formerly Midwest supervisor of the company's paint and related resin sales, has been promoted to supervisor of adhesive sales for New York.

The Dow Chemical Co.'s new sales office in Camden, N. J., will handle the company's plastics and other major lines in Pennsylvania, Delaware, Maryland, southern New Jersey, Virginia, and West Virginia. The staff consists of 24 salesmen headed by **Joseph G. Widua,** manager, who has been with Dow since 1945. The Camden office replaces the Philadelphia headquarters.

Shawinigan Chemicals Ltd.: Dr. R. S. Jane, formerly executive vice president, elected president; **Victor G. Bartram,** who retired as president, named chairman of

Raytheon selects **RESINOX* 3700** for core of new microwave cooking oven transformer



Monsanto material again demonstrates its outstanding physical-electrical properties!

Of all materials tested for the core of this intricate assembly—heart of a new microwave cooking oven—only Resinox 3700 qualified on every requirement.

For this highly critical application, Raytheon engineers needed a core material with outstanding electrical and physical properties. Unusual dimensional stability and low shrinkage were vital because the core is first wound, assembled, varnished and then baked at high temperatures. Core cracking under heat had been a common and costly complaint with the materials tested.

Since using Resinox 3700, these expensive losses and rejections of the final transformer coil assembly have been largely eliminated. Result? Faster, more economical production.

Other top-flight qualities of Resinox 3700, of special interest to electrical parts manufacturers, are its outstanding arc resistance, dielectric strength, good impact resistance, and excellent moldability.

This complete transformer assembly, used in both home- and commercial-type microwave ovens, is made and patented by Raytheon Manufacturing Co., Waltham, Mass. The core is molded by Spools, Inc., Providence, R. I.

Perhaps Resinox 3700 can solve a critical electrical parts problem for you. Write today for data sheets. Monsanto Chemical Company, Plastics Division, Room 665, Springfield, Mass.

MONSANTO

*Resinox: Reg. U.S. Pat. Off.

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the board. Mr. Bartram has also retired as president of **Canadian Resins & Chemicals Ltd., B.A.-Shawinigan Ltd.,** and **St. Maurice Chemicals Ltd.,** but remains a director of the three companies. **R. J. Southwell** succeeds Mr. Bartram as president of Canadian Resins & Chemicals.

General Electric Co.: Arthur C. Treece, new general manager of the company's Plastic Dept., replaces **John L. McMurphy** who is now manager of a special study-team on Chemical and Metallurgical Div.'s insulation activities. Headquarters for the department has been moved from Pittsfield, Mass., to Decatur, Ill. Reason given: Decatur is close to major markets for molded plastics and is the site of GE's largest plastics molding operation. The department also operates a plastics molding plant at Taunton, Mass., and mold-making facilities at Springfield, Mass.

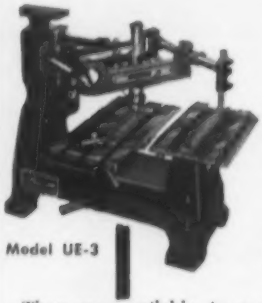
Paul A. Goodwin is new manager of technical service in the marketing section of the firm's Silicone Products Dept., Waterford, N. Y.

Harwick Standard Chemical Co., Albertville, Ala., is now distributor for GE silicone mold release agents and anti-foam materials (made by the Silicone Dept.) in the Southeast. The materials are used in rubber and plastic molding and finishing operations. **Albert Koper** is in charge of distribution. Harwick Standard Chemical Co. of California, 1248 Wholesale St., Los Angeles, will distribute the same materials in California.

Mobay Chemical Co.: Charles O. Koch, formerly technical services superintendent of the New Martinsville, W. Va., plant, is now with Mobay's development department in St. Louis, Mo., and will assist in the commercial development of urethane foams and surface coatings. **Ray M. Ewald** succeeds Mr. Koch in New Martinsville. **M. George Snyder** is now advertising manager of the company.

B. F. Goodrich Chemical Co.: Daniel L. Kent is now a technical service representative in the Plastic Materials Sales Dept. **Marvin W. Larson,** new director of Associated Company Relations, will implement the technological assistance contracts between BFG Chemical and its associated companies in Great Britain, Japan, Brazil, Mexico, and Canada.

Hooker Electrochemical Co. announces that its **Durez Plastics Div.'s Sales Dept.** is now responsible for sales of Hetron fire-resistant polyester resins, in addition to the Durez line of phenolic resins and molding compounds. **Alfred W. Hanmer, Jr.,** is Durez vice president in charge of sales. The Hetron sales group has been transferred from Niagara Falls, N. Y., to the division's offices at North Tonawanda, N. Y. **Charles Y. Cain,** former manager of plas-



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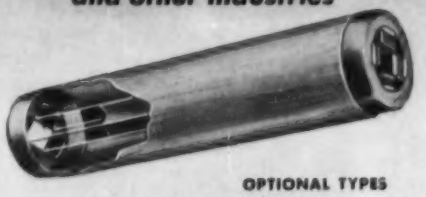

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tics sales for Hooker, has been named sales manager of Hetron polyesters. **Robert J. Entenman,** sales representative for Hetron, has been transferred from the firm's home office to 3120 E. 135th St., Cleveland, Ohio.

Dr. Richard J. Bellet, research chemist, has joined the resins and plastics group of Hooker's Research and Development Dept.

Irvington Varnish and Insulator Div.: Gordon Brown, former general manager of the Plastics Div., is now general manager of the Coating Div. **Erwin Brown,** formerly division engineer of the Electrical Products Div. of the parent company, **Minnesota Mining & Mfg. Co.,** succeeds Gordon Brown as head of Irvington's Plastics Div. **W. J. Stillwell,** previously head of the Coating Div., has been transferred to Minnesota's Electrical Products Div. in St. Paul, Minn.

Owens-Illinois Co.: James H. Flynn has been promoted to divisional service manager of the Closure and Plastics Div., succeeding the late Charles C. Neptune. **Charles A. Arthur** succeeds Mr. Flynn as service manager of the company's St. Charles, Ill., plant.

Colton Chemical Co.: Travis V. Rankin, new technical service representative in the west, will have headquarters at Emeryville, Calif. **Sondol E. Werner** is now East Coast technical service representative at 39 McClellan St., Newark, N. J.

American Cyanamid Co.: Assignment of **Mrs. Dorothy M. Gundlach** as color consultant on molding compounds includes technical and advisory service on color in relation to the end use of the company's molding compounds.

The General Tire & Rubber Co.: Thomas J. Lamond, promoted to production manager in charge of vinyl of its **Bolta Products Div.,** succeeds **William Murphy** who was recently named assistant factory manager. Mr. Lamond supervises the production of Boltaflex materials which are used as furniture and automobile upholstery and in the manufacture of inflatable toys and men's and boys' jackets. He is also in charge of the production of Bolta-Wall and other vinyl materials.

Dixon Corp.: Robert Rulon Miller, former vice president, is now president of the company. **William R. Potter,** former sales manager, promoted to vice president. **John A. Crowe,** former sales manager of new product developments of Bird & Son, Inc., has joined Dixon as sales manager.

The company specializes in the production of pure or alloyed compositions of Teflon, Du Pont's tetrafluoroethylene resin. In addition to fabricating special shapes to order, Dixon acts as a consultant on specifications for mechanical, electrical, chemical, and many other applications.

Chemical Process Co.: Milton A. Roberts appointed technical and service representative of the Ion

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- ***All-purpose!*** Kantstik works equally well on *all* types of plastics, *all* types of molds.
- ***Completely safe!*** Kantstik is non-toxic, non-flammable; it won't burn or stain the operator's hands or the molded item.
- ***Fully effective!*** Kantstik is a complex high polymer that forms a durable parting film between the mold and the molded piece.

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Exchange Div.'s new midwest sales office in Chicago, Ill. **Edward Chetakian** has joined the company's Plastics Div. as technical sales and service representative in southern California.

Goodall-Sanford, Inc.: R. J. Stewart & Co., 104 Old Whaling Lane, Beach Haven Terrace, N. J., and **Volland Industries, Inc.,** 6754 N. Clark St., Chicago, Ill., are now sales representatives for the Vinyl Fabrics Div. The Stewart firm will handle vinyl fabrics in the east central states; Volland will service manufacturers of automobile seat covers, outdoor furniture, hassocks, and jobbers of upholstered furniture in Michigan and Ohio, as well as some accounts in scattered areas.

Semet-Solvay Petrochemical Div., Allied Chemical & Dye Corp., has appointed **Thompson-Hayward Chemical Co.,** Kansas City, Mo., to service its polyethylene customers throughout the midwest and south central area of the United States.

Archer-Daniel-Midland Co.: Donald A. Beadell is new manager of industrial chemical developments of newly formed Development Dept.; **Dr. Verne C. Bidlack, Jr.** will work with resins and plasticizers.

Furane Plastics, Inc. announces that **Permacel Tape Corp.,** New Brunswick, N. J., will engage in the sale and distribution of Furane's Epocast epoxy electrical insulating resins.

Perry Plastics has moved to W. 14th St. and Marshall Dr., Erie, Pa.

National Research Corp.: H. A. Steinherz promoted to manager of the Mechanical Development Section. The section is responsible for the development of both diffusion and mechanical vacuum pumps. **Peter V. Schwab** named Pittsburgh, Pa., district manager of **NRC Equipment Corp.,** Newton Highlands, Mass. NRC Equipment is the sole North American sales representative for the line of high vacuum components, equipment, and systems produced by the parent company.

Horace Blackman Co., 5883 Blackwelder St., Culver City, Calif., has formed a Commercial Products Div. which will develop and market plastics items designed for the consumer market. Production will be handled by its affiliate organization, **Blackman Plastics, Inc.** Initial emphasis is on toys but other products will follow. **George Hammond Beck,** formerly president of Robert Hammond, Inc., manufacturer of plastic toys, is now sales engineer of the Blackman company.

Franklin Plastics, Inc.: Bob Litzinger elected vice president; **B. E. (Jack) Tate** named sales manager of the Products Div.; **Donald W. Andrews** replaces Robert E.

Lindquist as manager of the Custom Div.; and **Blair Kightlinger** succeeds Mr. Andrews as manufacturing superintendent.

Arthur D. Little, Inc.: Raymond Stevens elected president of the company succeeding **Dr. Earl P. Stevenson**, who is now board chairman.

The Macco Chemical Co., supplier of adhesives to the plastic wall tile industry, is now located at its new plant, 30404 Lakeland Blvd., Wickliffe, Ohio. **Richard S. Cole** has been placed in charge of sales for the Oil-Base Resin Adhesives Div.

The General Industries Co.: John Neuman, formerly owner of Nu Engineering, Chicago, Ill., named representative for custom molded plastics in Illinois, Iowa, Minnesota, and Wisconsin. **Dick Ursem**, formerly of The Dow Chemical Co., is sales engineer covering the Ohio territory.

Behr-Manning: John C. McGreivey named industrial sales manager for the New York area, succeeding A. F. Lehnhardt. **William J. Sweeney** is new Pacific regional sales manager, replacing Paul S. Wiswell who has retired. **Fredrick D. Stevens** succeeds Mr. Sweeney as industrial sales manager of the Los Angeles, Calif., division.

Harwick Standard Chemical Co.: D. F. Behney, James L. Weaver, Jr., and **William L. Lasser** elected to the board of directors. Mr. Behney was also named vice president in charge of sales.

The Society of the Plastics Industry, Inc. will be located at 250 Park Ave., New York, N. Y., starting May 1.

Foam King, Inc., has moved its laboratory-plant facilities to 1816 Boston Rd., New York 60, N. Y., and expanded them to a commercial production operation. The firm will manufacture basic vinyl plastisols to supply its licensees with the necessary formulations for foam production. The company will also manufacture a foamed sheet for use by the shoe trade (inner soles, outer soles, linings, etc.). In addition, the plant will be used as a school where prospective licensees will learn the techniques involved in the Foam King process.

Imco Container Corp.: Richard V. Vosburgh, promoted to executive vice president, will continue to head up the company's worldwide sales activities; **Lee H. Simmons**, formerly eastern sales manager, has been named a vice president and will continue in charge of Imco's eastern sales operations.

Manufactured Products Corp., 150 Huyshope Ave., Hartford, Conn., is the new name of the company previously known as **Plastics Div., Colt's Mfg. Co.** The firm custom molds plastics for packaging and industrial uses, and its facilities include injection, compression, transfer, and plunger molding.

C. W. Bentley is general manager of the company and **Herman P. Hopke** is sales manager.

The Borden Co.: Gordon E. Ketring is now assistant to **F. W. Linehan**, western sales manager of the Chemical Div. **Joel Edelstein** has joined the technical staff of the Resinous-Reslac Dept. He was formerly with B. F. Goodrich Co.

Food Machinery and Chemical Corp.: Alfred M. Bretschger, new manager of the Vancouver, Wash., plant of **Becco Chemical Div.**, succeeds **Henry P. Vogt** who is now manager of Becco's plant in Buffalo, N. Y. **Richard E. Elden**, chief chemist since 1951, is the new production manager at the Vancouver plant.

Blaw-Knox Co.: Carlyle W. Gilbert has been promoted to manager of the Resins and Plastics Dept., Chemical Plants Div. He was previously associated with Shell Oil Co., Inc. and Firestone Tire & Rubber Co.

Popular Plastics Products Corp., Northport, N. Y., is launching an expansion program for further development of its plastics premium products, housewares, and toys. A special program is also being planned for butyrate meter covers, already tested and in use by Long Island Lighting Co. Popular Plastics is a custom injection molder which designs and builds its own molds.

G. E. Matz has been appointed assistant to **Leonard E. Elterman**, president. He will act as liaison between Popular Plastic's Consumer and Industrial Products Divs. and all departments, including product design, engineering, assembly, and purchasing.

General Plastics, Inc., 7616 W. Michigan Ave., Kalamazoo, Mich., has been formed to specialize in extruding, injection molding, vacuum forming, and reinforced plastics molding. **M. K. Gibson** is president.

The Pantasote Co. announces that its subsidiary, **Tahoe Corp.**, 444 Madison Ave., New York, N. Y., and Passaic, N. J., will handle all orders for less than 1000 lb. of Pantasote Premium Plastics lightweight film. The Tahoe firm will stock all popular gages, colors, and finishes in lightweight film to service the New York and eastern areas and will also maintain stock in Chicago, Ill., for midwest customers.

Reed-Prentice Corp. has a new sales office at 1846 Owendale Dr., Dayton, Ohio, under the direction of **Eric Brierley**, formerly sales engineer in the Cleveland, Ohio, office.

Wheelco Instruments Div., Barber-Colman Co.: James T. Shelton named service engineer at the Buffalo, N. Y., office and **Walter Gilmore** service engineer at the New York, N. Y., office.

Fabricon Products: James R. Pendry has been named sales representative and application manager of the Impregnating Div.; **Clark Wormer** will serve in the same capacity in the Reinforced Molding Div.

Atlas Electric Devices Co., Inc., Chicago, Ill., has appointed two new West Coast representatives to handle both sales and service of Atlas Fade-Ometers, Weather-Ometers, Launder-Ometers, and related equipment. **John K. Bice**

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Co., 440 Seaton St., Los Angeles 13, Calif., will represent Atlas in southern California. **Pacific Coast Chemicals Co.**, 2060 Third St., Berkeley 10, Calif., will cover northern California.

William Brand Co., Willimantic, Conn., manufacturer of insulating tubing, wire, and cable for the electrical and electronic industries, has appointed **Don V. Hamilton & Co.**, 6516 Normandale Rd., Minneapolis, Minn., regional sales representative, covering the Dakotas, Minnesota, and western Wisconsin.

Peter Partition Corp. has moved to 124 Boerum Place, Brooklyn 1, N. Y.

Kemtek Corp., 210 Sylvan Ave., Newark, 4, N. J., has named **Buyers Service**, 15612 Euclid Ave., E. Cleveland, Ohio, and **Graef Engineering Co.**, 15010 S. Downey Ave., Paramount, Calif., as distributors of its extruded nylon rod. Kemtek is now extruding nylon rod in diameters from 3/16 to 1½ in., as well as blown nylon flat tubing with wall thicknesses from ½ to 5 mils.

Sealomatic Electronics Corp.: Miguel J. Afif, S. A. is Mexico City, Mexico, representative; **The Machinery Sales Co.**, Los Angeles, Calif., is West Coast distributor; **Robert Brandt, Plastic Molders Engineering Co.**, will handle sales and service in the Chicago-Milwaukee area.

Laminating Corp. of America has opened its new plant at 48 Bruen St., Newark, N. J., for custom dry laminating of vinyls to textiles or papers. **John Lonero** is president.

Web Controls Corp. is now located at 300 Straight St., Paterson, N. J.

Amchem Corp., Highland Park, Mich., has taken over the production of **Amchem Co.**, Taylor Center, Mich., and offers an expanded line of epoxy resin formulations—coatings; laminating and casting resins; adhesives and filling compounds; and floor coating materials. Officers of the new corporation are: **A. J. Zaehringer**, president; **J. C. Houston**, secretary; and **G. R. Osterlin**, treasurer.

Hartig Engine & Machine Co.: William F. Torres has joined the firm as a sales engineer. **C. J. Beringer**, Glenview, Ill., has been named Chicago representative.

Quelcor, Inc.: John R. Roberts, sales manager, elected to the board of directors, replacing **Mrs. Marion W. Pedlow** who remains as secretary of the company.

The Marblette Corp.: Precision Tool Sales, 417 E. Florence Ave., Los Angeles, Calif., named western representative.

Durable Formed Products, Inc., 6 Greene St., New York, N. Y., and **Speck Plastics, Inc.**, Port Wash-

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ington, N. Y., have entered into a "working agreement" to coordinate their plastics engineering efforts on a research and engineering level. The firms are not integrated financially and will continue to function independently; however, for large-scale projects, the two firms can combine their production facilities when exceptionally fast delivery is required.

Durable also announces the appointment of **Allen E. Terman** as technical sales representative, with headquarters at 540 N. Michigan Blvd., Chicago, Ill.

Personal

Howard S. Ortgies is now export manager of **The National Plastic Products Co.**, Odenton, Md. He will be responsible for the exporting of saran monofilaments, molded products, and high-pressure laminates.

Louis Miller Sherman has been appointed manager of market development of **Thiokol Chemical Corp.**, Trenton, N. J. Mr. Sherman's former affiliations were with Ethyl Corp., Chemical Construction Corp., American Cyanamid Co., and Du Pont.

William F. Condon, formerly with Owens-Corning Fiberglas Corp., is now sales manager of **Cordo Molding Products, Inc.**, 230 Park Ave., New York, N. Y. He will direct sales of Cordopreg, pre-impregnated reinforced plastic molding products which are used by molders and fabricators.

Howard Smith, new assistant general sales manager of **Bakelite Co., a Div. of Union Carbide and Carbon Corp.**, will have responsibility of pricing of materials and administration of contracts.

Albert S. Greenberg has been elected chairman of the board of **Zenith Plastics Co.**, Gardena, Calif.

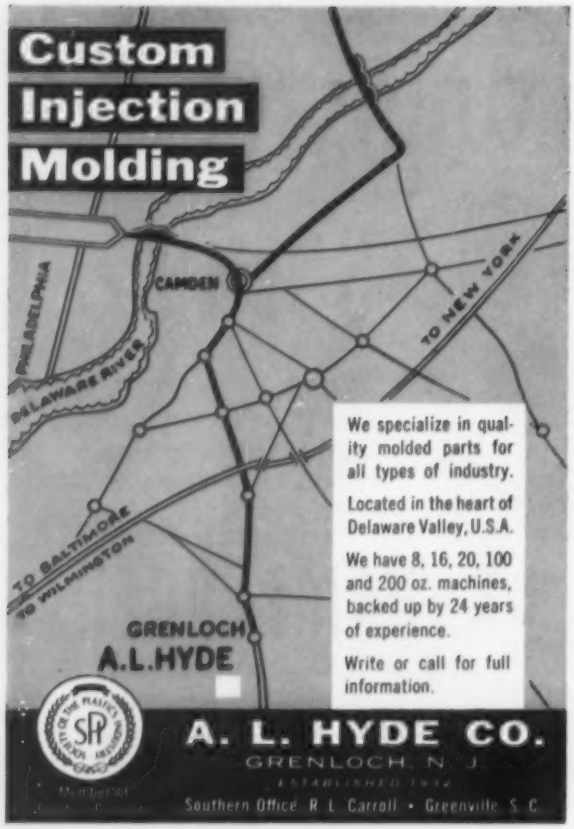
Lawrence P. Thies, assigned to the Cleveland district as a special representative of **The Goodyear Tire & Rubber Co.'s Chemical Div.**, will handle primarily sales of vinyl resins and Plio-Tuf high-impact styrene copolymer resins in Ohio, western Pennsylvania, and eastern Michigan.

Harry J. Karakas, named manager of The Process Equipment Div., **Rodney Hunt Machine Co.**, Orange, Mass., will be responsible for application, development, engineering, and sales activities of the division which makes rolls for embossing and printing equipment used in the plastics industry.

Forrest E. Phillips was promoted to sales manager of **Synvar Corp.'s Phenolic Molding Compound Dept.**, Wilmington, Del.

Alexander G. Koos has joined the Sales Development Dept. of the Plastic Div. of **Celanese Corp. of America.**

John J. Halvorsen, formerly technical director of plastic pipe and fittings of Continental Can Co., has joined **Orangeburg Mfg. Co.**,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The Plastiscope

Inc., Orangeburg, N. Y., and Newark, Calif., as manager of sales and development of the company's new Plastic Pipe Div.

Richard Neagle, industrial designer, has been retained by **Monsanto Chemical Co.'s Plastics Div.** to explore the esthetic and functional capabilities of plastics.

Ernie Munkacsy, now sales engineer of **Ferro Corp.'s Color Div.**, 4150 E. 56th St., Cleveland, Ohio, will cover Ohio, western New York, and Pennsylvania.

John A. Owen, Middletown, Ohio, consultant, who has recently completed a study of core materials for construction panels, has been retained by the **University of Cincinnati** to form a liaison with industry in connection with the Experimental Structures Program of the institution's College of Liberal Arts. Purpose of the program is to experiment with new forms and materials of construction.

Robert U. Haslanger has been elected vice president and general manager of **Escambia Bay Chemical Corp.**, Cambridge, Mass. He was formerly associated with Monsanto Chemical Co. and Stauffer Chemical Co.

William Duffy now chief plant engineer of **Stokes Molded Products Div., The Electric Storage Battery Co.**, Trenton, N. J.

Charles J. Beringer named midwest representative of **Plastics Color Co.**, Summit, N. J.

Donald Culver has been appointed head of **Murray Corp.'s Sales Div.**, Towson, Md., for the marketing of flexible plastic piping accessories.

J. Frees Brossy has joined **Houze Glass Corp.**, Pt. Marion, Pa., as plastics research engineer. The company is currently engaged in a research and development contract, drawing and evaluating new types of glass fibers for the Navy Dept.'s Bureau of Ordnance.

George J. Miller has joined the Customer Service Laboratory of Houghton Laboratories, Inc., Olean, N. Y., as applications engineer. He spent several years with General Electric Co., where he received a manufacturing award for work in plastic tooling.

Paul Bixler has been promoted to manager of the International Div., **F. J. Stokes Machine Co.**, Philadelphia, Pa.

O. Jules Poupitch has been named product development consultant of the fastening divisions of **Illinois Tool Works—Fastex and Shakeproof Divs.**

Francis V. Duffy, formerly with The Dow Chemical Co., is now director of **Foster Grant Co.'s Petrochemical Div.**, Leominster, Mass. Mr. Duffy will also work with H. Muehlstein & Co., New

York, N. Y., distributor of Fostarene, produced by Foster Grant for the injection molding industry.

Philip S. Hessinger is now research and development engineer of **Mycalex Corp. of America**, Clifton, N. J.

Deceased

Alfred A. Halden, 61, executive vice president and director of **National Starch Products, Inc.**, died of a heart attack. Mr. Halden joined the company in 1919 as a chemical engineer.

Meetings

Plastics groups

June 11-15: The Society of the Plastics Industry, Inc., Seventh National Plastics Exposition, New Coliseum, New York, N. Y.

June 11-15: The Society of the Plastics Industry, Inc., Annual Meeting and Conference, Commodore Hotel, New York, N. Y.

June 26: The Society of the Plastics Industry, Inc., Plastic Structures Division Conference, Hotel Roosevelt, New York, N. Y.

Other meetings

May 20-22: Building Research Institute, Fifth Annual Meeting, Sheraton-Brock Hotel, Niagara Falls, Ont.

May 22-23: Chemical Market Research Association Meeting, Biltmore Hotel, New York, N. Y.

June 6-8: American Society for Quality Control, Tenth Annual Convention, Le Palais du Commerce, Montreal, Canada.

June 6-9: Deutsche Gesellschaft für Chemisches Apparatewesen (DECHEMA), Annual Congress, Frankfurt am Main, Germany. Subject: "The Basic Principles of Chemical Engineering as Applied to Chemical Reactions on a Large Scale."

June 25-29: Orkin Expositions Management, International Housewares Show, New Coliseum, New York, N. Y.

July 10-12: Sixth Western Packaging and Materials Handling Exposition, Pan Pacific Auditorium, Los Angeles, Calif.

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Business opportunities

Equipment

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Machinery and equipment for sale

NEW ARRIVALS FOR SALE: French Oil Mill Mchy. Compression Molding Presses, 50-170 tons; 5 Preheaters 2KW; Wood 20"x20" 12" ram 170 tons; Southwark 24"x24" 12" ram, 170 tons; Baldwin Southwark 4-26"x26" 8" rams, 75 tons; 5-26"x26" 7" rams 57.7 tons; 2-15"x15" 8" rams 75 tons; 2-19"x24" 10" ram, 78 tons; 2-12"x12" 7½" rams 66 tons; 2-D&B 12"x12" 7" rams, 57.7 tons; 8"x9" 4½" rams, 24 tons; D&B 12"x12" 3" rams, 10 tons; HPM Transfer Molding 75 tons; Preform Presses, Colton 5½T Stokes R and DDS-2 MD; New Universal Dual Pumping Units 3-15 HP; Laboratory Mills and Calenders; also Extruders, Mixers, Vulcanizers, Injection Molding Units, etc. Universal Hydraulic Machinery Co. Inc., 285 Hudson Street, New York 13.

FOR SALE: 3—Ball & Jewell #2, #1½ Rotary Cutters; 1—Cumberland #0 Rotary Cutter; 4—Two Roll Mills 20"x22"x60", 15"x40", 6"x14"; 3—Baker Perkins 100 gal. 50 gal., 2 gal., jacketed double arm Mixers; 1—Stokes Rotary Preform Press #DDS2; 3—Stokes Model "R" single punch Preform Presses; 1—Kux Model 15-25 Rotary Press; Also: Sifters, Banbury Mixers, Powder Mixers, etc., partial listing; write for details; we purchase your surplus equipment; Brill Equipment Co., 2407 Third Ave., New York 51, N. Y.

FOR SALE: Hartig 3¼" Plastic Extruder. Stokes 150 ton semi-autom. hydr. Press. Kux 2½" dia. single punch Preform Machine. Farrel 15"x36" 2 roll Mill. Mills and Calenders up to 84". New Seco 6"x13" and 8"x16" Lab. Mixing Mills and Calenders. Plastic & Rubber Extruders. Brunswick 225 ton 21"x21" platens. Wat-Stillman 75 ton automatic Molding Press 20"x20" platens. 200 ton Hobbing Press 18"x14" platens. D&B 150 ton, 24"x24" platens. Adamson 80 ton 20"x20" platens. Farrel 200 ton 20"x80" platens. Southwark 30 ton 14"x14" platens, semi-auto. Also Lab to 2000 tons from 12"x12" to 48"x48". Hydr. Oil Pumps. Gould 75 HP motor. Dr. 2 stage Centrif. Pump 250#. W.S. 4 plgr. High and Low Pressure Hydr. Pump. Elmes Hor. 4 Plgr. 4500 lbs. and 5500 lbs. Hydr. Pumps & Accumulators. Stokes Automatic Molding Presses, Rotary & single Punch Preform Machines ½" to 4". Injection Molding Machines 1 oz. to 60 oz. Baker Perkins & J. H. Day Jacketed Mixers. Plastic Grinders. Heavy duty Mixers, gas boilers. Partial listing. We buy your surplus machinery. Stein Equipment Co., 107-8th Street, Brooklyn 15, N.Y. Sterling 8-1944.

FOR SALE: 1—Royle #4 Extruder, motor driven; 1—6" x 12" Laboratory Mill, m.d.; 1—Ball & Jewell Rotary Cutter, size O m.d.; 2—Baker-Perkins Size 15, 100 gal. Jacketed Mixers; 5—Horizontal Dry Powder ribbon Mixers, 4000#, 1500#, 500#; 1—New 3 Roll 6"x16" Laboratory Calender; 1—Farrel-Birmingham 60" Mill with reduction drive, 150 HP motor, floor level mounting; 1—Fitzpatrick "D" Comminutor, S.S. contact parts, jacketed; 1—Mikro Pulverizer #2th, with motor; 4—Reed-Prentice & W-S Injection Molding Machines, 2-16 oz.; Also other sizes: Hydraulic Presses, Tubers, Banbury Mixers, Mills, Vulcanizers, Calenders, Pellet Presses, Cutters. Send us your inquiries. What have you for sale? Consolidated Products Co., Inc., 50 Bloomfield Street, Hoboken, N.J. HOboken 3-4425, N.Y. Tel.: BArclay 7-0600.

AVAILABLE AT BARGAIN PRICES. W.&P. 200 gal. Jacketed Mixer with sigma blades, tilting type bowl. Baker Perkins 200 gal. Double Arm Mixer with sigma jacketed blades, can be used with and without vacuum dome. J. H. Day from ¾ up to 100 gal., Imperial and Cincinnatus D. A. Jacketed, Sigma Blade Mixers. Day 15 to 10,000 lbs. Dry Powder Mixers. Gemco 2000 lbs. 56 cu. ft. Double Cone Blender. Mikro Bantam, 1SH, 1F, 2TH Pulverizers. Day, Rotex, Tyler Hum-mer, Robinson, Raymond, Gayco, Great Western Sifters. Colton 2RP and 3RP Rotary Tablet Machines. Carver Laboratory 20 ton hydraulic Press. Package Machy. FA, FA2, FA4, Miller, Hayssen, Wrap-King, Scandia, Hudson Sharp, Oliver Auto. Wrappers—all sizes. This is only a partial list. Over 5000 machines in stock available for immediate delivery. Tell us your machinery requirements.
Union Standard Equipment Co.
318-322 Lafayette St.
New York 12, N. Y.

FOR SALE: (11) 75 ton record presses, complete @ $2,450, (11) new 100 ton, 10" ram, 10" stroke @ $1,100, (8) 200 ton, 9" stroke, 14" ram, 36x36 @ $1,850, (7) 200 ton, 9" stroke, 15" ram, 30x30 @ $1,650, (1) 50 ton complete, 18x18 @ $1,850, (1) 200 ton, 16" ram, 30x30 @ $2,450, (2) 200 ton, 16" ram, 42x42 @ $2,850, (1) 200 ton, 15" ram, 42x42 @ $2,450, (4) 250 ton, (2) 12" rams, 30x60 rebuilt @ $3,375. Hydraulic Sal-Press Co., Inc., 388 Warren Street, B'klyn, N. Y.

FOR SALE: Stainless Steel Rotary Dryer. Link Belt Co., 5'2"x16". No. 502-16, with all auxiliary equipment. Roto louvre also 6'x24' and 5'x26'. Hersey Stainless Steel Rotary Driers. Reply Box 8028, Modern Plastics.

FOR SALE: (2) 300 Ton W. S. Presses 20x 20 & 29x24 Platens. 140 Ton W.S. 22x16 Platen. 85 Ton Waterbury Farrel 20x24 Platen. 63 Ton Press 15x15 Platen with Pullback Cyls. 9, 8, 4, Oz. Injection Molding Machines. 15 Ton Lab. Presses 10x8 Platen. 10 Ton Lab. Presses 6x6 Platen. Standard Mystic Embossing Presses, Accumulators, Pumps, Valves. 250 Ton W&S 28x24 Platens, 80 Ton Farrel 24x24 Platens. Many other Presses—Send for Bulletin. Aaron Machinery Co., Inc., 45 Crosby St., New York 12, N.Y. Tel.: WAlker 5-8300.

FOR SALE: 60 oz. H.P.M. w/1200 ton clamp; 48 oz. Lester; 48 oz. DeMattia; 32 oz. Lester, 1950, $22,000; 32 oz. R-P, 1950, $26,000; 40 oz. H.P M., 1949, $27,000; 16 oz. R-P, 1948, $13,000; 16 oz. Impco, w/10 oz. cyl., $7,500; 16 oz. H.P.M. 1951, $15,000; 16 oz. H.P.M. 1946, $8,000; 12 oz. DeMattia w/16 oz. prepack, fully hyd., 1951/52, $10,000; 12 oz. DeMattia, $7,000, Terms; several 12 oz. Lesters; 8 oz. Reed-Prentice 1952, $9,500; 8 oz. R-P, single link, $3,750; 8 oz. Leominster, $3,750; 9 oz. H.P.M. 1946, $5,000; 9 oz. Monson, $5,500; 6 oz. R-P, $7,000; 8 oz. Reed-Prentice, rebuilt, $7,000; 4 oz. Lester, $3,000; 4 oz. Lester, fully aut., 1953, $8,500; 4 oz. Lester vert., $5,000; 4 oz. Watson-Stillman, $4,000; 4 oz. H.P.M., 1948, $4,500; 4 oz. Impco; 3 oz. Fellows, 1953, $8,000; 3 oz. Fellows 1951, $5,500; 2 oz. semi-aut. Van Dorn, lever type, $2,000; 2 oz. Moslos, 1954; Stokes presses, all types; DeMattias, horiz. & vert.; Italian extruders, granulators, Ovens; Let us list your surplus equipment. Acme Machinery & Mfg. Co., 102 Grove St., Worcester, Mass.

GIRDLER THERMEX: "15 KW High Frequency Pre-heater" used for thermo-setting materials, in excellent operating condition. Can furnish F. C. C. certification. Reply Box 8002, Modern Plastics.

FOR SALE: 4000 ton Hydraulic Press by John Shaw; table 8'x4'; two rams with Pumping Unit. 3700 ton Multi-platen Press by John Shaw, 9'x4'6", two rams with self-contained Pumping Unit. 3000 ton Belting Press, 18'x7'6" steam platens; six rams, Pumping Unit. 3000 ton Down-stroke Hydraulic Press, table 10'x8'. Large stock of other rebuilt Hydraulic Presses, Mills, Calenders, etc. Reed Brothers (Engineering) Ltd., Millwall, London, E.14. Cables—Replant London.

FOR SALE.
Injection Machines: Two P-48 (48 oz. with pre-plasticizers) H.P.M.s excellent condition like new, 1½ years old. One 10-D-12 (12 oz.) Reed Prentice excellent condition, new 1950. One 10-D-8 (8 oz.) Reed Prentice, just rebuilt, excellent condition, new 1947. One Lester 16 oz. fair condition, new 1946. All running and available for immediate delivery. Available 7 days a week for inspection by appointment. Reply Box 8004, Modern Plastics.

FOR SALE: 1—37x37"—10 opening hydraulic press, 30" ram; 4 Adamson 20x20" hydraulic presses, 15" ram; 1 Wood 30 ton self-contained compression press; 1 Hartig 2" extruder; 2 Stokes rotary preform presses, DDS-2, BB-2; also grinders, mixers, mills, etc. Chemical & Process Machinery Corp., 52 Ninth St., Brooklyn 15, N.Y.

FOR SALE: Laminator 65" width Dilts Type, 18" diameter steam rolls, five (5) 30" diameter cooling or heating drying drums, two double set squeeze rolls, variable speed DC motor set, refrigeration unit, motor and control two steam jacketed tanks. Machine can be seen in operation. Reply Box 8008, Modern Plastics.

FOR SALE: Rotogravure, laboratory machine 18" wide, rewind and unwind. Vickers drive 1-200 revolutions. Could be altered to a production machine. Price $700.00. A few printing rollers. Optional. Raymond Barea, 626 W. 136th St., Apt. 8, New York 31, N. Y.

(*Continued on page 266*)

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(*Continued from page 264*)

FOR SALE: Injection Presses: 4, 8, 12, 24 oz. Reeds, 2, 9, 16 oz. HPM. 32 oz. vertical HPM. 8, 12 oz. Lester. 4 oz. Lewis. 12 oz. Watson. 3 oz. Vertical Munton. 1 & 2 oz. Van Dorn. Extruders: 4½" oil heatd. NRM, 2" steam htd. NRM Saran extruder & pipe set-up. Conveyors. Cumberland Granulator No. 1—Ovens. —48" Stokes Vacuum Metallizer Setup. Markem Imprint Mach. No. 25 A. Compression & Transfer presses 50 to 600 Ton. Preform presses: Colton 5½ T & 3. Kux No. 60 B dbie. set.—Auto-Vac 52"x30" Vac. Form. Mach. 200 T Hobbing press. 2—Laminating presses 18"x18" Pl. 4 open. All Midwest locations. List your surplus equipment with me. Justin Zenner, 823 Waveland Ave., Chicago 13, Ill.

FOR SALE: Marco Process consisting of: Homogenizer, Roto-Feed Mixers, Reactors, Kom-Bi-Nators, Pumps, all stainless steel. Heavy Duty Double Arm Sigma Blade Mixers. (2) Readco 50 gal. 30 HP; (2) W & P 100 gal.; (2) J. H. Day 75 gal. stainless steel; (1) Banbury #3 with 75 HP motor. (2) Kux Rotary Pellet Presses. (4) Sprout-Waldron Horizontal Ribbon Mixers 236 cu. ft. (12,000#) capacity. (1) St. St. Pug Mill 7" diameter x 3'9" long overlapping chambers, jacketed 75#. (4) Mikro Pulverizers #2DH, #2TH, #3TH. (3) Fitzpatrick Stainless Steel Comminuting Machines, Models D, K & F. We Buy Your Surplus Equipment. Perry Equip. Corp., 1429 N. 6th St., Phila. 22, Pa.

FOR SALE: Hydraulic Presses: R. D. Wood 2500 Ton, 8-Opening, 84"x54" Steam Platens. Elmes 1000 Ton Hobbing. M. D. Pump. Birdsboro 882 Ton, Down-Acting, 48"x48" Bed. Self-Contained. HPM 750 Ton, Down-Acting, 59"x44" Bed, Self-Contained. Farrell 625 Ton, 52"x52" Platens, Self-Contained. Watson-Stillman 600 Ton, Hobbing, M. D. Pump. Farrell 393 Ton, 2-Opening, 43"x48" Steam Platens, Elmes 350 Ton, Down-Acting, 30"x36" Bed, Self-Contained. Lake Erie, 215 Ton, 36"x36" Platens, Self-Contained, Semi-Automatic (4). Lake Erie, 300 Ton, 30"x 30" Platens, Self-Contained, Semi-Automatic. Carey 150 Ton, 21"x16" Platen, Adj. DLO 8"-28" (3). Farquhar 100 Ton, Down-Acting, 30"x28" Bed, Self-Contained. Farquhar 100 Ton, Drawing, Down-Acting, 29"x34" Bed, High-Speed, Slf.-cont. H.P.M. 100 Ton, Fastraverse, Down-Acting 30"x30" Bed, Self-Contained. Watson-Stillman 100 Ton, Down-Acting, 22"x20" Bed, Self-Contained. Watson-Stillman 100 Ton, Burroughs 75 Ton, HPM 35 Ton Molding Presses. Dake 75 Ton Die Tryout Press, Practically New. Watson-Stillman and Elmes 30 Ton and 20 Ton Lab Presses. Baldwin-Southwark 50 Ton, Angle Molding Press. Loomis 40 Ton, 4 Opening 12"x12" Steam Platens. Francis 40 Ton, 4 Opening, 12"x12" Elec. Ht. Platens. Stokes Model 200D-2, 15 Ton Automatic and Stokes 300, 200, 150 and 100 Ton Semi-Automatic Molding Presses, All Self-Contained. Injection Machines: De Mattia, Model B, 24 Oz. HPM, Model 350-H-16, 16 Oz. Reed-Prentice, 12 Oz., 1952 Machine. HPM 200-H-9, 9 Oz. (2). Reed-Prentice, 8 Oz. IMPCO, 8 Oz. Vertical, Model VF-8, Late Model. Watson-Stillman, 2 Oz. Van Dorn, Model H-200, 1 Oz. and 2 Oz. Tablet Machines: Stokes S-5, RD-4, RDS-3, R-4, R and T; Colton #5½, #5, #2-RP and #3-RP, KUX 64. Extruders: Royle Nos. 1, 3 and 4; Allen-Williams 8"—All Individual Motor Drive. 3½" Electrically Heated Extruder. MPM 1½" Electrically Heated. Practically new. Mills: Farrell 18"x50" (4); Farrell 16"x40" (3); Farrell 15"x36" (2)—Available As Mill Lines Or As Individual Units. Rotary Cutters: Cumberland No. 0, 2 HP M. D. Ball & Jewell 1 HP M. D. Stainless Steel. Ball & Jewell 1 HP M. D., Plain Steel. Ball & Jewell Heavy Duty Ideal, 5 HP M. D. Miscellaneous: Sturtevant Blenders: 1 #2 20,000 Lbs. Capacity —Practically New. 2 #10 13,000 Lbs. Capacity—Never Used. Stokes Vacuum Impregnating Equipment. Vulcanizers, Grinders, Pumps, Valves, Platens, Etc. Johnson Machinery Company, 683P Freilnghuysen Avenue, Bigelow 8-2500, Newark 5, N.J. What Have You For Sale? What Are You Looking For?

FOR SALE: Mitts and Merrill, Type "A" R.H. Hog, Steel cylinder, roller bearing equipped, extended shaft and outboard bearing for belt drive. Extra set cylinder knives and necessary wrenches (less pulley). Structural steel base under outboard bearing, Hog and motor for above Hog—20 HP, 1160 RPM, open frame, squirrel cage ball bearing, 220/60/3, Louis Allen frame #365. Starter for above motor, magnetic across-the-line type with push button station. "V" belt drive consisting of: 1—4-Groove "C" section pulley, 9" P.D., 1⅞" I.D.; 1—4-Groove "C" section pulley, 13" P.D. 2¼" I.D.; 4—"V" Belts C-85. Less than 5000# of material run through the above equipment. Haas Corporation, Mendon, Michigan.

FOR SALE.
One 10D-8 oz. Reed Prentice Injection Molding Machine. In Good Condition. Can Be Inspected While In Operation.
Reply Box 8003, Modern Plastics.

FOR SALE: Lester Injection Molding Machines 4, 8, 12 and 16 oz.—W-S and Baldwin Hobbing Presses 150 to 2000 ton —Bolling Laboratory Presses 50 to 150 ton —Molding Presses and Pumps—new ¾" Hi-Speed Hydraulic 3000 psi Double Solenoid Hydraulic Control Valves—partial listing—we buy used plastic molding equipment. Plastic Machinery Exchange, 426 Essex Avenue, Boonton, N. J. Telephone DE 4-1615; Cable address "Plasmex-Boonton."

Machinery and equipment wanted

WANTED: 12 ounce Dematlia injection machine, 1950 or later. Reply Box 8001, Modern Plastics.

WANTED TO BUY: 6½" to 8" late-type plastic extruder and Banbury mixer. Webco, Inc., 8200 Bessemer, Cleveland, O., DIamond 1-8311.

WANTED: Used single punch hydraulic pre-form press. Good condition, for phenolic pills up to 4" diameter. Reply Box 8021, Modern Plastics.

WANTED: Used Cameron slitter and rewinderscore or shear cut 36" to 72", any condition. Reply Box 8018, Modern Plastics.

WANTED: Hydraulic Press: New or used, 54"x100" minimum platen area; 1, 2 or 3 openings; 10 psi minimum pressure; 250°F maximum operating temperature; upward acting platen desired. In reply, please give all details regarding operation, construction, price, location and availability. Reply Box 8044, Modern Plastics.

WANTED: Polishing tumblers (dry), 4 to 6 oz. Injection molding press preferably Reed, air compressor, Barry Belt Sorter —Buttondex. Sell compression Button molds—Ring fish eye & pants styles. Reply Box 8016, Modern Plastics.

Materials for sale

FOR SALE.
8,000 lbs. Virgin Light Green High Impact; 12,000 lbs. Reprocessed Red and Yellow High Impact; 20,000 lbs. Natural and Colors C-11; 15,000 lbs. Bright Colors Polyethylene; 15,000 lbs. Transparent Red Methyl Methacrylate Taillight Formulation; 50,000 lbs. Rigid Solid and Mixed Colors Vinyl; 25,000 lbs. Virgin and Reprocessed Vinyl Compound for injection or extrusion. Samples and prices on request.
A. Bamberger Corp.,
703 Bedford Ave.,
Brooklyn 6, N. Y.
MAin 5-7450.

CAN YOU USE vinyl plasticizers which are off-color? If you make window channeling, extrusions, welting, hose, etc., we can save you money! 10,000 lbs. DIOP in drums; 16,000 DOP; 16,000 ODP; 30,000 DOS; 20,000 w/w ATEC. Also: 8,000 lbs. H-I Polystyrene, 2,000 clear & 6,000 mixed colors, virgin— Make us a ridiculous offer! Chemsol, Inc., 74 Dod St., Elizabeth, N. J., EL-4-7654.

FOR SALE: (800) hundred (50) gal. drums plastic stripable sprayable transparent military SPC-AXS 1756 REV 1-type 1-class B-lab. Test sample sent on request, best offer. Etherton Sales Co., P O Box 333, Renton, Washington.

FOR SALE: 5,325 pieces .020x12"x15½" Gold Metallized Butyrate @ $.374 each original cost. This represents prime stock that is on hand as a result of an order cancellation. Best offer, f.o.b. Kansas City, Missouri, will take immediately. Reply Regal Plastic Company, 2800 East 14th Street, Kansas City, Missouri.

Materials wanted

WANTED.
Plastics Scrap and Rejects of all kinds, Ground and unground. Also rejected molded pieces and surplus virgin molding powders. Top prices paid.
A. Bamberger Corporation
703 Bedford Ave., Brooklyn 6, N. Y.
MAin 5-7450

WANTED: Plexiglas and Lucite scrap, salvage and cut-offs, any quantity. Turn your surplus sheet stock into cash. Ask for our quotation. Duke Plastics Corp., 584 Broadway, Bklyn 6, N. Y. Evergreen 8-5520.

PLASTIC SCRAP: Polystyrene, Hi Impact Polystyrene, Polyethylene and Acetate. Top Prices Paid. Plastic Moulding Powders, Inc., 2004 McDonald Ave., B'klyn 23, N. Y. ES 5-7943.

WANTED: Plastic Scrap. Polyethylene, Polystyrene, Acetate, Acrylic, Butyrate, Nylon, Vinyl. George Woloch, Inc., 601 West 26th Street, New York 1, N. Y.

Molds for sale

FOR SALE: Complete line of Houseware Molds, Comb Molds, also some novelty and specialty items. No reasonable offer refused. Send for list. Reply Box 8029, Modern Plastics.

Plants for sale

FOR SALE: Completely equipped ten-man tool room specializing in plastic mold manufacture. Includes 7 Millers, 6 lathes, 4 grinders, 2 shapers, etc., and complete stock—gauges, small tools, etc. Can purchase as business or machinery only. Excellent opportunity for someone wanting to go into business. Located in North Jersey, convenient to large number of plastic molders. Time payments arranged. Reply Box 8020, Modern Plastics.

Help wanted

CHEMICAL ENGINEER OR CHEMIST: Experienced in electrical sheet stock manufacturing. Must have proven record in formulation and compounding for resin molded laminated phenolics, compression molding press equipment and treaters. Forward resume of personal qualifications and experience and past salaries. Plant located in Michigan. Reply Box 8043, Modern Plastics.

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A MONTECATINI PRODUCT
AVAILABLE IN VARIOUS GRADES
FOR CALENDERING, EXTRUSION,
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PROMPT DELIVERY FROM STOCK
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CHEMORE CORPORATION 21 WEST STREET, NEW YORK 6, N. Y. TEL.: HA. 2-5275

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REINFORCED PLASTICS ENGINEER. Prefer man with chemical or chemical enginering background for opening in development and project engineering group on government and consumer products. Permanent position with excellent advancement opportunity and employee benefits in leading company in the reinforced plastics field. Send complete resume including salary requirements to:
Manager Salaried Employment
The Brunswick-Balke-Collender Co.
Marion, Virginia.

WANTED: Chief Engineer for Medium Compression and Transfer Molder located in Western Pennsylvania. This is an excellent opportunity for the right man to join a young progressive company. Salary open. Reply Box 8000, Modern Plastics.

PLASTIC SALESMAN WANTED by Chicago area Custom Injection Molder. We are in the process of expanding and have a newly created position for the right man with proven background of accomplishment in Sales. Opportunity to become Sales Manager with executive capacity. Salary plus commission. Reply Box 8032, Modern Plastics.

CHEMIST. Plastic Printing Inks: Experienced in manufacture of printing inks for gravure printing on vinyl film and sheeting. Permanent position. Excellent salary. Write fully. Reply Box 8015, Modern Plastics.

ENGINEER—EXTRUDING EXPERIENCE: Large diversified multi branch company wants alert, aggressive young engineer with polyethylene extruding experience to help setup, then supervise polyethylene film extruding operation in Ohio. Good potential for an able, serious man with experience. Indicate age, health, education, present position and job history. Reply Box 8006, Modern Plastics.

EXTRUSION: Midwest—AAA-1 Rating. Compounding and Custom Extrusion operation requires experienced man for die design, development, and sampling. Give full resume of experience, education, references, and salary requirements in first letter. Replies held confidential. Reply Box 8048, Modern Plastics.

WANTED.
Tape Chemist to head up development and control of manufacturing processes on pressure sensitive tapes, with primary emphasis on Vinyl supported adhesive tapes. Applicant should hold C.E. or B.S. Degree, and have at least 2 yrs. experience in this field. Write giving full details of experience, salary, etc. This is a sound, long range program with old established company. No price—firmly established—but salary will be commensurate with ability.
Reply Box 8042, Modern Plastics.

PLANT MANAGER: Plastics Scrap Plant. Must be familiar with scrap sorting and grinding. Excellent opportunity. Reply Box 8050, Modern Plastics.

CHEMISTS AND CHEMICAL ENGRS. For product development in plastics field. Outstanding opportunity to join recently formed Product Development Department of the Atlas Powder Company, located in Wilmington, Delaware. 5-10 years experience in polymers and their application uses required. All responses held confidential. Direct all replies, marked personal to,
R. L. Herrman
Atlas Powder Company
Wilmington, Delaware

SHEET EXTRUSION FOREMAN: A Chicago corporation has a fine position for a man with high impact sheet extrusion experience. This position is permanent with a good starting salary and a wonderful opportunity for advancement. All replies treated confidentially. Reply Box 8045, Modern Plastics.

PLASTICS EXTRUSION OPERATOR & Ass't Extrusion Foreman: Wanted by progressive New York City firm. Pleasant working conditions, chance for advancement unlimited by "seniority" and other restrictions. Excellent opportunity for right man—applications treated with strictest confidence. Write, giving full details to: President, Box 8030, Modern Plastics.

HELP WANTED: Plastics mold designers (2), 1-2 years experience, preferably injection. New England area. Reply Box 8038, Modern Plastics.

VINYL CHEMIST.
Manufacturer calendered film and vinyl sheeting requires experienced chemical engineer or chemist. All replies confidential.
Reply Box 8039, Modern Plastics.

REINFORCED PLASTICS: Newly created Reinforced Plastics Division of one of America's leading growth companies has an opportunity available for a man interested in assuming individual technical responsibility for products testing program. Mechanical or civil engineer graduate with advanced degree or experience in strength of materials preferred. Our products include: Tapes, coated abrasives, adhesives and coatings, electrical insulating and recording products, reflective sheeting, reinforced plastics, printing products, duplicating products, chemical products, etc. Starting salary commensurate with training and experience. Advancement based on individual merit. Location in St. Paul, Minnesota provides easy access to outstanding hunting, fishing and vacation areas. Write: Technical Employment Department, Minnesota Mining & Manufacturing Company, St. Paul, Minnesota.

PLASTIC CALENDERING FOREMAN. Thoroughly experienced in calendering unsupported vinyl film and/or sheeting. Plant Metropolitan N. Y. Steady position, excellent salary. Reply Box 8055, Modern Plastics.

FACTORY MANAGER: Midwest injection molding plant. 30 to 40 years of age. Must have good technical background in molding techniques and engineering, a broad working knowledge of painting and plating of plastics and a good basic knowledge of complete company operations of this type. Good personality and ability to handle people is important. Future potential in this company excellent. Reply Box 8034, Modern Plastics.

VINYL COLOR MATCHER.
Man experienced in color matching and production color control in film and sheeting.
Reply Box 8041, Modern Plastics.

PLASTIC SALES ENGINEER: We are seeking a well qualified man experienced in plastics extrusion for attractive Market Development position. Kindly give your education, experience, and expected salary in complete resume. All replies will receive careful attention and will be held confidential. Write: 108 Personnel Department, Chemical Division, Koppers Company, Pittsburgh 19, Pa.

POLYETHYLENE EXTRUSION SUPERVISOR.
Must be thoroughly experienced in extrusion of light gauge tubular film. Plant Brooklyn, N. Y. Steady position. Excellent salary, write fully. Reply Box 8056, Modern Plastics.

PRODUCTION FOREMAN: Progressive young company in North Carolina needs experienced production foreman to take charge of injection and compression molding department. Right man must have long practical experience in all phases of molding shop operation. Attractive salary, also stock options for the man who is really right for the job. Former New Englanders with the company find friendly, sunny North Carolina a wonderful place to live and work. If you are a first rate production man, you may find the situation you have always wanted by immediately sending photo and complete resume which we will keep confidential. Do it right now. Interview at our modern new plant will be arranged at our expense. Reply Box 8052, Modern Plastics.

CHEMICAL ENGINEER OR CHEMIST: Opportunity to sell synthetic resins to molding and coating industry for nationally known concern. Age 25-40. Experience preferred, but not essential. Our staff has ben advised of this advertisement. Send resume. Reply Box 8046, Modern Plastics.

FLOOR TILE CHEMIST.
Experienced manufacture vinyl tile. Location, Midwest. Liberal insurance and pension plan.
Reply Box 8040, Modern Plastics.

SALES MANAGER WANTED: Experienced in merchandising of plastic films, sheetings, and coated fabrics. Location New York City. Please send resume first letter. Reply Box 8057, Modern Plastics.

YOUNG MAN WANTED with limited plastic experience but with selling ability for a sales position with a small growing custom compression molding company located in New Jersey. Salary. Reply Box 8013, Modern Plastics.

WANTED—CHEMIST.
Experienced in the vinyl coating industry who has specialized in the coating of fabrics, paper, and webbing for such industries as Upholstery, Automobile, etc. Location—New England.
Reply Box 8047, Modern Plastics.

Situations wanted

EXTRUSION ENGINEER: 6 years experience; now in plastics extrusion, technical service and design. Also experienced in process construction and field engineering, personnel supervision and administration, laboratry developmental experience. B.S. in Chem. Engr. Age 27. Married. Top fifth of graduating class. Well grounded in theory and capable of practical problem solutions. Desires responsible position in plastic field. Reply Box 8054, Modern Plastics.

SALES SERVICE MANAGER: Gentleman, 32 years of age, married, family. Employed by large Eastern concern 10 years, currently selling out of new Midwest office. Broad experience in thermoplastic sheet and bottle field. Managed and supervised various departments. Conversant with product development, systems, order dept., sales correspondence, scheduling, production, pricing and office management. Prefer New England area. Salary $10,000. Reply Box 8024, Modern Plastics.

PROFESSIONAL PLASTICS ENGR.: Desires consulting with firm planning expansion or entrance into reinforced plastics field. Fourteen years diversified plastics and rubber experience: design, development, production and sales. Recognized reinforced plastics expert with a pleasing personality and ability to administer a complete organization. Chemical Engineer (BSE), Mechanical Engineer (MS). 10787 Wellworth Ave., Los Angeles 24, California.

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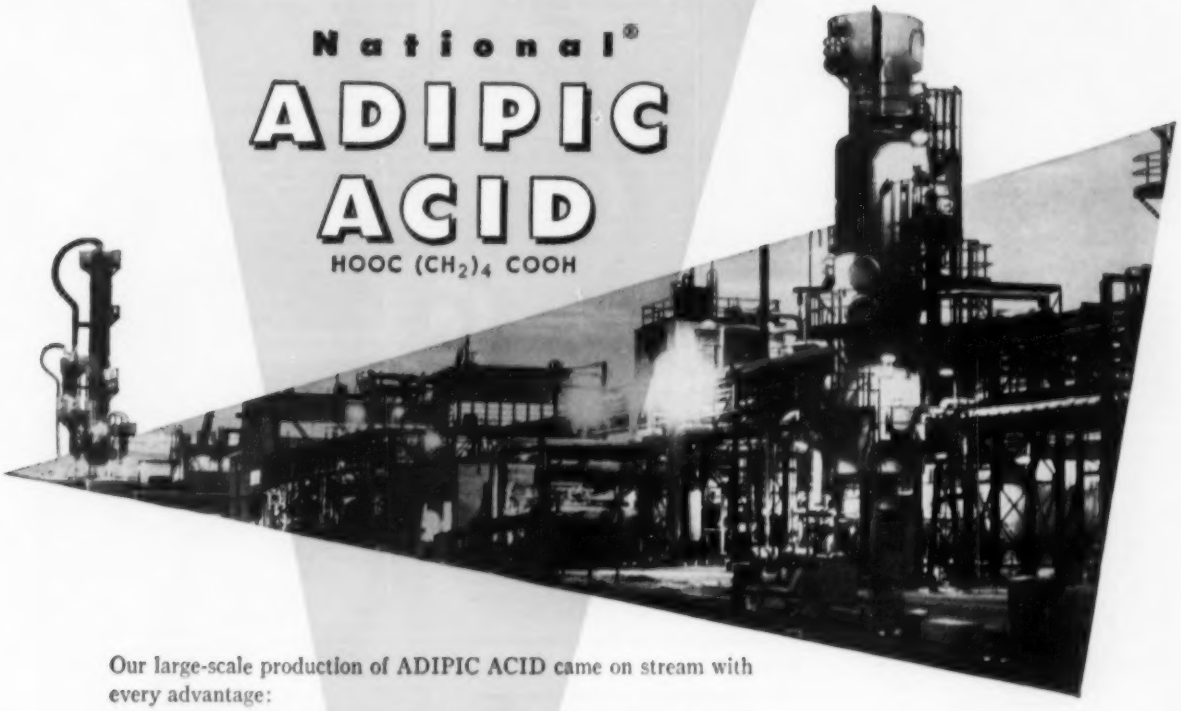

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An efficient, continuous process yielding an outstandingly high quality product—99.7% minimum purity, light color and low iron.

If you make or contemplate making adipates, adipic polyesters or polyurethans, you should investigate the advantages of National ADIPIC ACID. It can be used with complete satisfaction in the rubber, plastics, plasticizer, lube oil and chemical industries. We will be glad to send samples, technical data and quotations.

SEND FOR TECHNICAL BULLETIN I-12

This comprehensive 8-page technical bulletin on National Adipic Acid gives physical and chemical properties; principal reactions of the carboxyl and alpha methylene groups; solubility curve, and suggested uses with copious literature references.

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ALLIED CHEMICAL & DYE CORPORATION
40 RECTOR STREET, NEW YORK 6, N. Y.

Boston Providence Charlotte Chicago San Francisco Atlanta Portland, Ore. Greensboro Philadelphia Richmond Cleveland Los Angeles Columbus, Ga. New Orleans Chattanooga Toronto

Allied Chemical

(Continued from page 268)

CHEMICAL ENGINEER: 8 years of plastic and industrial coatings experience. Extrusion, formulating, product development, color matching, machine design and layout work, electrical circuits. Line supervision, personnel relations, technical service and sales liaison work, trouble shooting. Would like to apply diversified and versatile background to a sales or technical service position with a growing organization. Reply Box 8014, Modern Plastics.

BLANKING AND FABRICATOR with twelve years experience in acrylic materials desires permanent position with reputable manufacturer. Experience includes four years plastic fabrication, eight years blanking, and blanking supervision of which all phases to do with blanking of acrylic plastics. Please send resume. Reply Box 8053, Modern Plastics.

MECHANICAL ENGINEER: Experience in vacuum and drape forming. Also wide experience in plastic packaging. Experience includes design of automatic vacuum forming and packaging equipment. Desire design position. Reply Box 8036, Modern Plastics.

Sales agents wanted

SALES AGENT.
Exclusive attractive contract open for New York and surrounding territory for representative to handle manufacturer's line of injection molding machines. Experience and acquaintance among injection molders preferred. Give complete details and plastic lines now handled, if any, in first letter. Replies held confidential. Interview will be in New York.
Reply Box 8051, Modern Plastics.

REPRESENTATIVE: Progressive, growing Injection Molder with capacity up to 16 oz. including latest high cycle automatic equipment seeks representation in Midwest areas. New modern plant in Chicago area. Reply Box 8035, Modern Plastics.

MFR'S. REPRESENTATIVE: Wanted for West Coast territory by large Eastern plastic molding machine and mold manufacturer on commission basis. Reply Box 8009, Modern Plastics.

SALES REPRESENTATIVES: Wanted by Custom Injection Molding Company. We are interested in men who are now calling on Industrial Accounts. Located in Midwest with modern and up-to-date facilities. Desirable territories open. Commission basis. Reply giving territory wanted. Reply Box 8017, Modern Plastics.

WELL KNOWN MANUFACTURER seeks active distributor for outstanding line of material processing equipment to cover Eastern Pennsylvania, Maryland, and Delaware area. Write stating lines presently handled and sales representation. Reply Box 8022, Modern Plastics.

VINYL FOAM SALES REP.: Aggressive with following in Vinyl Plastics and electronic heat-sealing fields, wanted by national distributor of Vinyl Foam. Various national territories open. State complete background. References. Excellent opportunity for right man. Reply Box 8005, Modern Plastics.

SALES REPRESENTATIVE.
Wanted in St. Louis territory to sell custom molding on commission basis for top grade molder specializing in thermosetting and nylon electro-mechanical parts. Should be familiar with all phases of selling involving tooling. Reply to:
Whitso, Inc.
9330 Byron St.
Schiller Park, Ill.

PLASTICS MANUFACTURERS REP.: Fine opportunity to grow with plastic vacuum forming manufacturer. We are in the process of expanding and have several territories still available to selected sales representatives currently calling on engineers and buyers of custom plastics. Send complete resume of experience and territory now covered. Reply Box 8010, Modern Plastics.

SALES AGENTS WANTED: Long established custom injection molding company in New York City seeks commissioned representatives with industrial or other contacts. Familiarity with injection molding process desirable. Most territories open. Reply Box 8037, Modern Plastics.

MANUFACTURERS' REPRESENTATIVE: Wanted for Ohio and adjoining territories by Compression Custom Molding Firm. Reply Box 8007, Modern Plastics.

MFR'S. REPRESENTATIVES.
Needed by reliable producer of own proprietary molded articles for household, hardware, sporting goods, and novelties. Straight commission basis. Please state territory. Will give exclusive to concern with necessary potential.
Reply Box 8019, Modern Plastics.

MANUFACTURERS REPRESENTATIVE: Wanted by Chicago area Custom Injection Molder. Modern plant with tool room. Molding capacity up to 16 oz. with facilities for finishing molded parts. Commission basis. Most territories open. Reply Box 8031, Modern Plastics.

SALES REPRESENTATIVES WANTED: Leading manufacturer of metallized Mylar film and laminations now setting up national distribution. Lucrative territories are open for aggressive representatives. Reply Box 8058, Modern Plastics.

Miscellaneous

WANTED: Shoe horn mold, send sample and full particulars. Cameron Incorporated, 4611 N. Clark St., Chicago 40, Ill.

WANTED TO BUY.
Plastics Scrap Business: All or controlling interest. Will consider retaining management and personnel.
Reply Box 8023, Modern Plastics.

BE THE FIRST with a plastics plant in fast-growing, fabulous central Florida. Our tremendous influx of people has created a great demand for consumer goods and industrial products now being shipped from the North. This market, low cost plants, and good labor-management history are attracting new industries and branches. Pleasant and economical living conditions insure an ample supply of workers in spite of below-average wage scales. Plant City, centrally located in peninsular Florida, has two railroads, airport, main highways, is progressive and cooperative. There are virtually no plastics fabricators in central Florida. Eliminate absenteeism with happy, efficient workers in this healthy climate. Be the first, start a plastics plant and grow with us. Write now, or visit the Plant City Development Committee, P. O. Box 1509, Plant City, Florida.

PLASTIC TOY HAND ORGAN: There is nothing like it on the market. I have a working model that plays all the tones including bass, and is very loud and clear. Will demonstrate or send a photo. Seeking future quantity orders or contract. What is your proposition? Charles Feltman, 1434 Fernwood Ave., Lakewood, New Jersey.

TAX LOSS CORPS. WANTED.
Interested in Tax Loss Corporations in all phases of the Plastics industry. No proposition will be too small or too large for us to consider.
Reply Box 8026, Modern Plastics.

PLASTIC MFRS. ATTENTION: Commercial Designer has developed novel one piece Cigarette Case. (Patent Pending.) No top, no moving parts; approximately ⅝ oz. Mold in one piece for few pennies. Application: Advertising Giveaway, Premium Trade, Consumer Item. Model—Specifications available to legitimate inquiries. Entertain exclusive franchise to established organization capable of producing and selling in volume. Reply Box 8027, Modern Plastics.

SWITZERLAND Manufacturers Representative wants to represent first class American concerns for the sale of their products in Switzerland. We have been selling for over ten years to the Reinforced Plastics Industry, the Electrical and Packaging Industry. Reply Box 8033, Modern Plastics.

PATENT FOR SALE or with deal on royalty basis. Patented Plastic Shower Bath Helmet. Practical item and also the unusual novelty gift for Christmas, mothers day, weddings, anniversaries, etc. Other prospects are bath houses at industrial plants, golf clubs, military installations, first-class tourist camps, etc. Millions can be sold. Write: J. M. Johnson, 3743 South 48th St., Lincoln, Nebraska.

CANADIAN REPRESENTATION: Increase your present volume. Sell in Canada's expanding economy. Two aggressive McGill graduate engineers with excellent business contacts seek exclusive distribution for American manufacturers. Experience combines thermo-plastic, thermo-setting raw material and finished product sales, as well as formulation, development and production of various chemical products. Reply Postal Box 624, Montreal, Canada.

MICHIGAN REPRESENTATION.
Manufacturers Representative, active in Michigan 20 years, wants sources for custom molded Teflon and Nylon. High level contacts in automotive, electrical, aircraft and other industries in this area. Commission basis.
Reply Box 8025, Modern Plastics.

COMPRESSION MOLDERS: Manufacturer (Steel Products) utilizing services of 21 salesmen, located key cities in United States and Canada, interested in purchasing large quantities of reinforced plastic items. Steady, all year round volume. We will pay for molds. Source should be located in N. J., N. Y., Conn., eastern Pa. or Md. Reply Box 8049, Modern Plastics

All classified advertisements payable in advance of publication

Closing date: 28th of the second preceding month, e.g., Apr. 28th for June issue

Up to 60 words $10.00	Up to 120 words $20.00	Up to 180 words $30.00
Up to 60 words (boxed) $20.00	Up to 120 words (boxed) $40.00	Up to 180 words (boxed) $60.00

For further information address Classified Advertising Department, Modern Plastics, 575 Madison Avenue, N. Y. 22, N. Y.

Companies you can trust

...trust Norton

● In that first morning hour when people are still trying to awaken fully, their favorite "breakfast companion" is a hard-working kitchen item, the coffee percolator.

And, in many thousands of homes, the coffee percolator is the one shown here, a copper-clad beauty made by Rome Mfg. Co. division, Revere Copper and Brass, Inc. Norton Laboratories has supplied molded handles for these percolators for several years, handles that stand up well against the abuses of daily use. They are just one example of the many compression and injection molded items Norton has produced for the Revere company during the last 25 years.

This 25-year association is a typical Norton-customer relationship, and that's a fact Norton is particularly proud of. It shows more clearly than any words that "companies you can trust—trust Norton."

Next time *you* have a molding job, call in Norton. On every count—engineering, production, delivery, price—you'll be glad you did.

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Sales Office: New York—175 Fifth Avenue; (Chicago) Elmhurst, Ill.—203 Elm Square Building; Cleveland—20605 Kings Highway; Detroit—3-167 General Motors Building; Philadelphia—4719 Longshore Street; Rochester—739 Powers Building.

NORTON *Laboratories, Inc.*

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Opportunity to make original contributions to Plastics Development

Chemists and Chemical Engineers with some experience in handling polymeric materials are needed for development work in a growing plastics component of large, long-established, progressive company in upstate New York. Work includes development of specialized plastic compositions, fabrication techniques and new applications. Excellent possibilities for professional growth and advancement.

Please send resume to

BOX 8011

Plastics Engineer

Excellent opportunity for project engineer or assistant project engineer with broad plastics background, to work on the development and research of aircraft quality plastics.

Mechanical or chemical engineering degree required, plus a minimum of 3 to 5 years' experience in foam plastics, rubber, and reinforced plastics.

FOR APPOINTMENT FOR INTERVIEW

Send typewritten resume, giving complete details of education, past experience and current earnings to:

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MGR., ENGINEERING RECRUITMENT, DEPT. P-3
CURTISS-WRIGHT CORPORATION, WOOD-RIDGE, N.J.

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Make a good product better with **chem-o-sol**, the plastisol formulation with unique properties!

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Possibilities for new and improved products through use of **chem-o-sol** are unlimited. This easily manageable liquid vinyl dispersion forms a tough flexible solid with high abrasion resistance. Available in practically any color, it is readily applied in mass production by dipping, molding, spraying, die-wiping, knife-coating or roller-coating.

Our completely equipped laboratories and experienced chemists stand ready to assist you in formulating the *exact* **chem-o-sol** to solve your product problem.

Bulletin 141 tells what chem-o-sol is, how to use it, what it can do for you. Write for your free reference copy today.

Chemical Products CP CORPORATION

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50 Wiegand, Edwin L., Company
224 Wilner Wood Products Co.
243 Wilross Products Company
16 Windsor, R. H., Ltd.
49 Wood, R. D., Company
55 Worbla Ltd.
175 Worcester Moulded Plastics Co.

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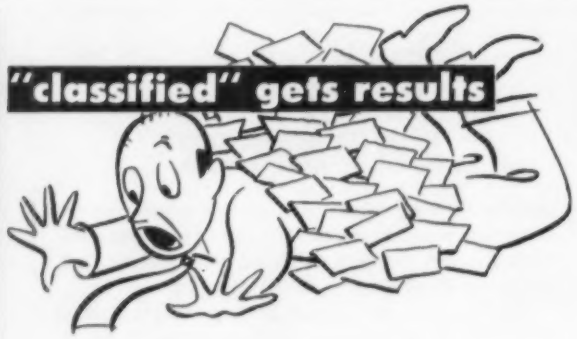

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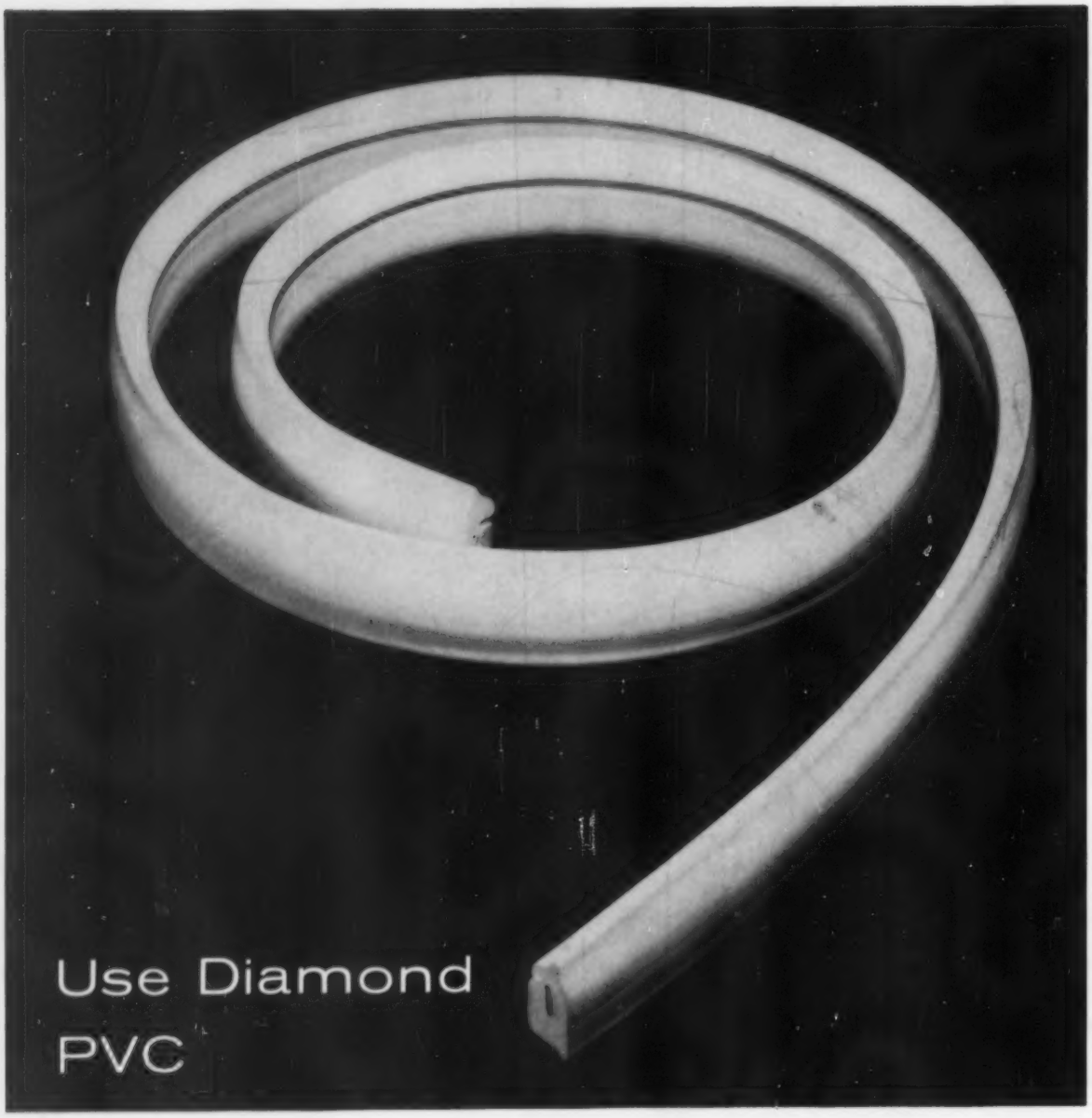

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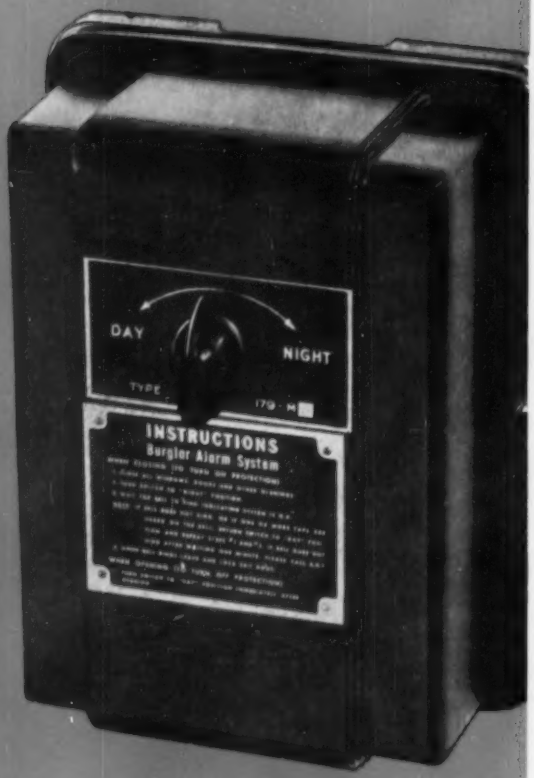

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